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THE GRANDE SOUFRIÈRE OF GUADELOUPE.

BY

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One of the objects of the second expedition sent, in 1903, to the West Indies by the American Museum of Natural History, was the study of the other volcanoes of the Caribbean chain in order to compare them with Mont Pelé and the Soufrière of St. Vincent. In pursuing this study, several days were spent by the author upon the island of Guadeloupe, and two ascents of the Grande Soufrière were made. The visits to the summit of the mountain were favoured by superb weather, and led to the making of observations which may be of general interest, in view of the fact that not much has been published in the United States regarding the volcanoes of the island.

The island of Guadeloupe is the largest of the Lesser Antilles, if we include in our reckoning both parts of the land mass which is intersected by the Rivière Salée. The two portions of the island are entirely distinct in character, the eastern portion, known as "La Grande Terre," being composed of limestone beds of Tertiary Age, while the western portion, known as "Basse Terre," is almost wholly volcanic in origin, and is extremely mountainous in character. The islands called "Les Saintes Îles," which lie to the south of Basse Terre, are the remains of one or more volcanoes.

The limestones which make up the Grande Terre contain abundant corals and other fossils. The beds have been elevated to a comparatively slight degree above sea-level—the highest point is only 450 feet above the sea—and have not been subjected to folding and faulting to any extent. According to Robert T. Hill the limestones form a veneer upon an old eroded foundation of volcanic origin. The southwestern portion of this part of the

island has been extensively eroded, leaving narrow ridges between the streams, while the northeastern portion shows more plateau land intersected by gorges. The topography indicates that there have been here at least two periods of elevation. Low limestones and coral reefs connect Grande Terre with Basse Terre, forming the isthmus which is cut through by the Rivière Salée. These beds extend to the base of the mountains in the northeastern part of the western island. Conglomerate is exposed at various altitudes up to 1,000 feet above the sea at several points of Basse Terre. Coral reefs exist all along the northern and eastern coasts of Basse Terre and along a considerable portion of Grande Terre. Marie Galante, Désirade, and other smaller islands in the immediate vicinity of Grande Terre are likewise of limestone, and show a comparatively young stage of erosion.

The mountains forming the Basse Terre section of Guadeloupe present a series of ancient volcanoes which has been so deeply eroded as to remove any apparent traces of craters from most of them. The movement of volcanic activity appears to have been from the north to the south; at any rate, erosion has proceeded farther at the north than at the south, and the peaks rise to successively greater elevations towards the south, culminating in the Grande Soufrière, which rises to an altitude of 4,868 feet above the sea, and is the highest mountain in the Lesser Antilles. Although the only marked volcanic activity on the islands of Guadeloupe is confined to the Grande Soufrière and its immediate vicinity, the most perfectly-formed crater is that known as "La Citerne," about a mile south of the summit of the Soufrière and at a considerably less elevation. The summit next in elevation to that of the Grande Soufrière is Morne Sans Toucher, which rises 3½ miles N.N.W. of the Soufrière to an altitude of 4,855 feet. Between these peaks rises the Grande Découverte (4,134 feet), while immediately to the southeast of the Soufrière, and between it and La Citerne, is the Morne l'Échelle (4,485 feet). Morne l'Échelle is of particular interest because a series of new and rather active fumaroles has opened upon its northwestern flank facing the Soufrière.

Interest in Guadeloupe centres for the most part about the Grande Soufrière, the summit of which lies about 5½ miles in a straight line northeast of the town of Basse Terre, the capital of the colony. The ascent of the mountain is not a difficult matter, now that the enterprising Club des Montagnards has improved the old paths and opened new ones through the forests on the moun-

tain and has established places of refuge for the comfort and convenience of visitors. The Club was organized April 7, 1903, with M. C. Thionville as President and Dr. C. E. Colardeau as Vice-President. A visit to the summit of the mountain is best accomplished from the town of Basse Terre. The trip may be made in one day, but it is more satisfactorily and comfortably done by driving to Camp Jacob in the afternoon, spending the night there, making the remainder of the ascent the following day and return-

FIG. 1.
THE GRANDE SOUFRIÈRE OF GUADELOUPE FROM BASSE TERRE; DISTANCE 5⅓ MILES. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 16, 1903, BY E. O. HOVEY.

ing to Camp Jacob for the succeeding night. The Club des Montagnards has erected a comfortable cabin at the picturesque Bains Jaunes, at 3,100 feet above the sea, in the upper part of the dense forest, which makes it possible to spend the night within an hour's walk and climb of the summit. Beyond Bains Jaunes, a favourite resort on account of the warm sulphur baths, the forest begins to diminish, and at 4,284 feet above the sea trees cease to grow.

The summit of the mountain is barren of vegetation, except for the wild pineapple, moss, grass, ferns, and similar plants which grow in the hills and in protected places. The gentle treeless slope at the southwestern base of the cone, which goes by the

name of "Mule Savanna"—though no one knows the reason for the appellation—abounds in a beautiful terrestrial orchid. This plant flourishes only between the altitudes of 3,800 and 4,250 feet above the sea, and to enjoy its beauty and its fragrance one must visit its native habitat, for thus far it has resisted all attempts at transplanting.

The seasons of the year must be carefully observed by the traveller who would ascend the Grande Soufrière in such weather as will repay him for his exertions. The mountain is so lofty that its summit forms a region of almost constant atmospheric condensation, and is covered with clouds the major portion of the year. The record of observations by M. Le Boucher* for the year 1898 gives: Entirely free of clouds throughout the course of the day, 27 days; free from clouds at intervals, 103 days; entirely covered, 235 days. A similar record for 1899 gives: Entirely free from clouds during 35 days; free at intervals, 134 days; entirely covered, 196 days. The clearest days may be expected in March and April, when the mountain sometimes remains free from clouds a week or even a fortnight at a time. September also is a favourable month, and three or four days together of clear weather occur occasionally in December and more frequently in January.

Whatever the temperature may be at sweltering Pointe-à-Pitre or at Basse Terre, or even at delightful Camp Jacob, where the Colonial Governor has his residence, one is always sure to have need of warm clothing upon the summit of the Grande Soufrière. A series of observations with a self-registering thermometer, placed in an exposed position where the nocturnal radiation would have its full effect, gave Le Boucher the following record of temperatures:

October 8, 1896.....	− 1° C.
December 27, 1896.....	+ 6° C.
January 2, 1897.....	+ 4° C.
March 15, 1897.....	+ 3° C.
April 6, 1897.....	+ 1° C.

The same author states that on the summit the temperature in the shade during the day does not rise above 18° C. (64° F.) or fall below 7° C. (45° F.). The Club des Montagnards established a barograph and a set of accurate thermometers on the summit in April, 1903, and is carrying on systematic observations on the atmosphere which will provide valuable data for the study of the climate of the high elevations in the Caribbees.

* Léon Le Boucher, "La Guadeloupe Pittoresque," p. 32. Basse Terre (Guadeloupe), 1900.

From Basse Terre the appearance of the profile of the mountains suggests the idea that the cone of the Grande Soufrière rises within the walls of a great crater, the limits of which are indicated by Morne l'Échelle to the south and the height known as the "Nez Cassé" to the north. This impression is dissipated, however, when one stands upon the summit of the mountain and examines attentively the relations of the cone to the surrounding peaks, including those just mentioned.

FIG. 2.
THE GRANDE SOUFRIÈRE: SUMMIT FROM THE ROAD FROM BASSE TERRE TO CAMP JACOB. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 16, 1903, BY E. O. HOVEY.

On the north the base of the cone is surrounded by a narrow plateau, which slopes gently southward; that is, toward the cone. Nez Cassé is farther north, across a deep valley. To the southwest the plateau is continued into a rocky ridge extending towards Basse Terre. Towards the east the little plateau merges into the body of the cone, and along the eastern and southern sides cannot be distinguished therefrom. The relationship suggests that the present cone has been formed upon the site of a pre-existent crater which has been obliterated with the exception of the narrow ring upon the north and west sides.

The cone of the Soufrière consists for the most part of solid rock, which projects from the sides in massive buttresses and from the top in jagged pinnacles. The largest of these pinnacles have received distinctive names, such as "Piton du Sud" (or "Piton Dolomieu"), "Piton du Nord" (or "Piton Saussure"), "Portes d'Enfer," "Les Aiguilles," "Piton Breislach," "Dent de l'Est," etc. These various projections above the top of the cone closely resemble the smaller spines and masses formed on the summit of the new cone of Mont Pelé, Martinique, in 1902 and 1903. Between the buttresses of solid lava composing the major portion of the cone a rock formed of débris (tuff agglomerate) may be seen.

There seems to be no definite crater, in the usual acceptation of the term, in the cone of the Soufrière, although there is an irregular depression in the southern half of the summit, which goes by the name of the "Grande Plaine," and there are several smaller hollows. The top of the cone is an irregular plateau about 1,000 feet long from north to south and 850 feet wide from east to west, which is dangerous to traverse away from the beaten paths and the barren rocks by reason of crevices which are concealed by the wild pineapples and the carpet of moss.

The cone is traversed by two series of profound fissures that intersect each other at a small angle near the highest point of the mountain, which is practically the centre of the summit plateau. The largest of these fissures, which preserves a nearly north and south course through the cone, is known as the "Grande Fente," or Great Fissure. At its widest part this cleft is about 75 feet in breadth; its depth varies greatly on account of the material that has fallen in from the sides. At the north end the cleft is open nearly to the base of the cone, and evidently extends to a much greater depth, since this is the location of the principal fumarole of the volcano, which goes by the name of the "Cratère du Nord." Toward the southern side of the cone the Grande Fente forks into two fissures which have not been traced down the slopes of the cone.

For a hundred feet, horizontal measurement, close to the northern edge of the summit plateau, the Grande Fente is very active, steam issuing copiously from at least four openings which comprise the "Fumerolles du Nord." One of these is said to discharge boiling water after a particularly heavy fall of rain. The largest of the vents is a hole, about 9 by 6 inches in dimensions, at the surface of the ground. Steam issued so vigorously here on April 18, 1903, one of the days which the author spent on the summit,

that a stone 6 inches in diameter was supported readily upon the column of vapour, but was not ejected. Considerable sulphurous gas, apparently sulphuretted hydrogen (H_2S), is present in the escaping steam. Sulphur deposits rather rapidly from this in small crystals. On April 17, 1903, the temperature of this fumarole, 6 inches below the surface, was 105° C. The southernmost of the fumaroles was only a scarcely perceptible jet of steam in 1896.

The northernmost of the fumaroles of the Grand Fente are just beyond the edge of the summit plateau. They seem to be two in

FIG. 3.
THE GRANDE SOUFRIÈRE. FITON DU SUD, FROM THE SUMMIT PLATEAU, LOOKING SOUTHWEST. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 17, 1903, BY E. O. HOVEY.

number, and they comprise the Cratère du Nord. They are the most vigorous of the volcano, and are thought by some observers to have thrown out ashes in January and February, 1903. Doubt is cast upon the value of the observation by the Pelé ash, which was then still to be found on the vegetation of the mountain. These fumaroles are said to have come into activity during the eruption of 1797. They coat the walls of the fissure with a constantly-renewed surface of brilliant sulphur crystals. Sulphur stalactites hang from projecting points of rocks and the air is burdened at times with sulphurous fumes. The steam issues through the great fissure with the force and terrifying noise of an enormous safety-valve.

Rains wash the yellow mineral from the walls down to a pool in a lower part of the Grande Fente, which hence goes by the pretentious name of the "Lac de Soufre." Le Boucher has penetrated the fissure here far enough to see, in a chasm below the upper outlet of the steam, another sulphur lake more worthy the name than that visible from the outside of the fissure.

The temperature of the steam rising from the Cratère du Nord has never been taken, although it would be possible to determine it by means of a self-registering thermometer well incased in metal. The Grande Fente at this point consists of a fissure from one foot to fifteen feet in width, cutting through the solid lava. The rock, which is andesite, is much decomposed. It is roughly columnar in structure, and vertical columns form the walls of the fissure. Observers state that during seasons of abundant rain the volume of steam is greater than it is during dry periods.

Prior to 1843 the Grande Fente was open to the base of the cone, where it enlarged, forming a grotto which was known as the "Caverne de Spallanzani." The cavern was discovered by Peyssonnel, the royal physician living in Guadeloupe about 1730, and a great explorer of the Soufrière. In 1843 a great landslide occurred, which obliterated the lower portion of the fissure and closed the entrance to the cavern, which was below the Lac de Soufre and was about 4,385 feet above sea-level.

The grotto is described as having consisted of three chambers; the first, the walls of which were coated with beautiful crystals [of sulphur ?], was about 164 feet in depth, and led to the second, which, according to the enthusiastic writers of the day, presented a magic aspect, the light of the torches being reflected on all sides by the brilliant surfaces of [sulphur ?] stalactites* of strangely varied form. The second chamber measured more than 820 feet in depth, beyond which the third chamber opened to unknown extent. The atmosphere of the first chamber was fresh, that of the second was hot and difficult to breathe, while that of the third was irrespirable, extinguishing the torches almost immediately. Terrifying sounds of rushing water issued from the lowest of the three chambers.

A hundred yards to the west of the landslide just mentioned an avalanche occurred in earlier times, leaving a great trench in the lower slopes of the cone. Between these points the side of the cone is covered with loose masses of rock, and the whole is impregnated with sulphur, and has the appearance of freshly-incinerated mate-

* This being a cavern in volcanic rock, calcareous stalactites are, of course, entirely out of the question.

rial. No vegetation exists on this part of the cone, and steam is said to issue from the ground from time to time.

The continuation of the Grande Fente can be readily traced across the little plateau known as the "Savane," which seems to have been the old crater-rim (Morne Amic). Along this extension are situated the new "Fumerolles de Colardeau," four in number,

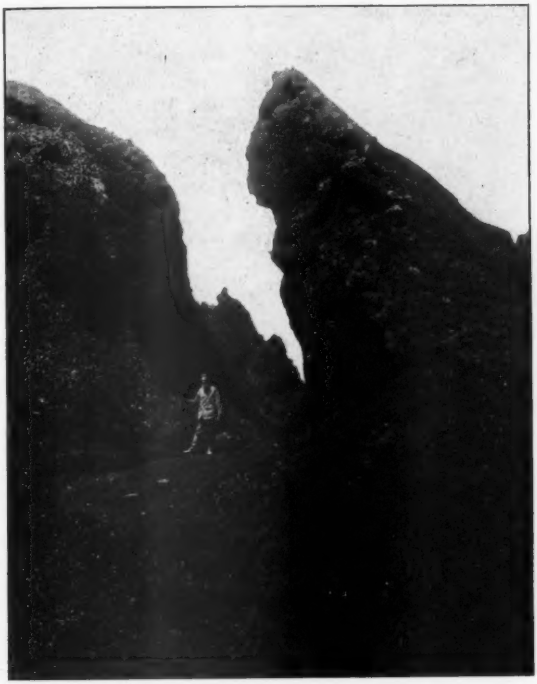


FIG. 4.
THE PORTE D'ENFER: ON THE SUMMIT PLATEAU FROM THE NORTHEAST.
PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 17, 1903,
BY E. O. HOVEY.

two of which were discovered on October 28, 1902, by Dr. C. E. Colardeau of Basse Terre. The temperature of the steam issuing from these vents varies from 76° to 92° C. Determinations made April 17, 1903, gave 86° and 88° C. for the two vents on the outer edge of Morne Amic. The steam, which at this time gave only a faint odour of sulphur, was issuing with sufficient pressure to make a low sound. Vegetation was beginning to die in the neighbourhood of the new fumaroles.

Near the centre of the summit plateau, one crosses the Grande Fente, which here trends due north and south, by means of the Natural Bridge, which has been formed by the fall of huge masses of rock from the sides of the fissure. The dangers of this route have been greatly enlarged upon by travellers, and the bridge is so narrow, and the gulf on either side so deep, that one has need

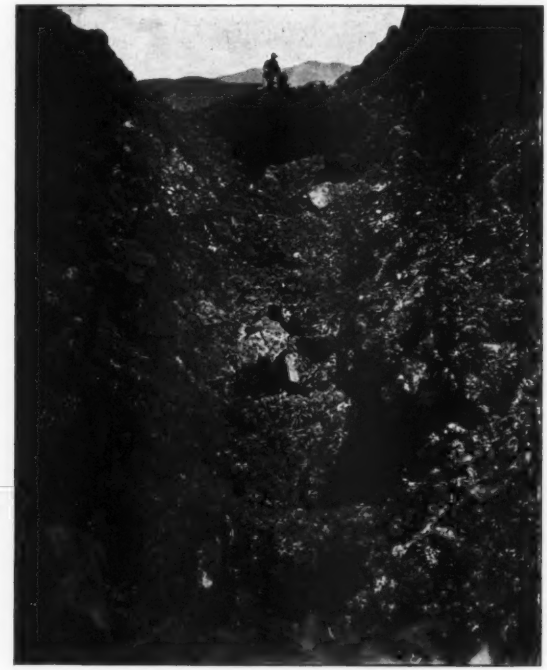


FIG. 5.
THE GRANDE SOUFRIÈRE. THE PONT CHINOIS, A NATURAL BRIDGE ACROSS THE SECONDARY GREAT FISSURE IN THE TOP OF THE CONE. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 18, 1903, BY E. O. HOVEY.

of a steady head. The chasm north of the Natural Bridge is called the "Dupuy Gulf," while that to the south is named for a M. Tarissan. These two gulfs or chasms form the most impressive part of the Grande Fente, which is sixty feet wide at the Natural Bridge. The "Tarissan Gulf" is the deeper of the two; accurate measurements are not at hand, but 125 feet would be a moderate estimate for the distance of the lowest visible part of the yawning

chasm below the pathway on the Natural Bridge. A luxuriant growth of ferns carpets the bottoms and sides of these gulfs, the place being protected from the fierce winds which sweep almost constantly over the mountain.

The intersecting fissure, which has a general direction of N. 40° W., is deeply incised along the top of the cone, where it has

FIG. 6.

THE GRANDE SOUFRIÈRE: CENTRAL PORTION OF THE GRANDE FENTE FROM THE SOUTH. THE FISSURE HERE IS ABOUT 75 FEET WIDE AND FROM 50 TO 75 FEET DEEP BELOW THE LOWEST PORTIONS OF THE EDGE. THE BLOCKS, WHICH HAVE FALLEN, HAVE WIDENED THE TOP AND CHOKED THE BOTTOM OF THE FISSURE. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 18, 1903, BY E. O. HOVEY.

a breadth of about forty feet and a maximum depth of fifty to sixty feet. In two places fallen rocks arch across this fissure, forming natural bridges, which are known as "Pont Chinois" and "Pont du Diable." For a hundred yards the chasm is a conspicuous feature of the summit, becoming shallower and narrower toward the north. It is less pronounced on the northern slope,

where it has been christened the "Fente Hovey" by the Club des Montagnards. The fissure may be traced nearly across the Savane at the base of the cone.

To the southwest, across the Grande Fente, the subordinate fissure can be readily traced to the base of the cone. Along a transverse crevice, 75 feet northeast of this fissure, in one of the higher parts of the mountain, are the "Cratères de Napoléon," the best-known, perhaps, of all the vents of the Soufrière. The craters consist of two very strong fumaroles. Steam issues at a temperature of 100° C. Dr. Colardeau reports, "Napoléon was roaring on May 25, 1902." This crater or series of fumaroles is stated to have been formed during the eruption of 1836. The activity is thought to be on the decrease.

Where the northwest-southeast fissure cuts the southern edge of the truncated cone, the chasm, which is less than ten feet wide, is open to a great depth. The trend of the fissure here is about N. 35° W. Exact determination of the depth never has been made, but the reverberations of stones thrown into it are said to have been heard for 17 seconds. The author's observation was that the noise from a descending stone was heard for 14 seconds, which confirms the observations of Le Boucher and others. Le Boucher reports that the last sound coming from a falling rock indicated the existence of a pool of water in the bottom of the chasm. This gulf, which is known as the "Cratère," or "Volcan du Sud," is one of the most impressive features of the Soufrière. No steam issued from it for about ten years prior to 1903. It is now steaming gently, and Dr. Colardeau states that when he visited the locality in 1883 the vent was active.

The fissure continues irregularly down the slope of the cone, and half-way to the bottom there is an old and well-known vent, which was quiet for many years, but which sprang into life again in 1902. This emits steam at a temperature of 98° C., and is one of the indications that the activity of the Soufrière is gradually increasing. The Club des Montagnards has named this vent the "Fumerolle" or "Cratère Lacroix," in honour of the French geologist Professor Alfred Lacroix.

Guadeloupe has long been known as an active volcano. De Rochefort,* in speaking of the island of "Gardeloupe," says:

> Certain of these rivers in descending roll along logs of wood coated with sulphur, which have passed by the mines of sulphur which are in one of the most cele-

* Histoire naturelle et morale des Iles Antilles de l'Amerique," Chap. 3, Art. V. 8vo. Rotterdam, 1665.

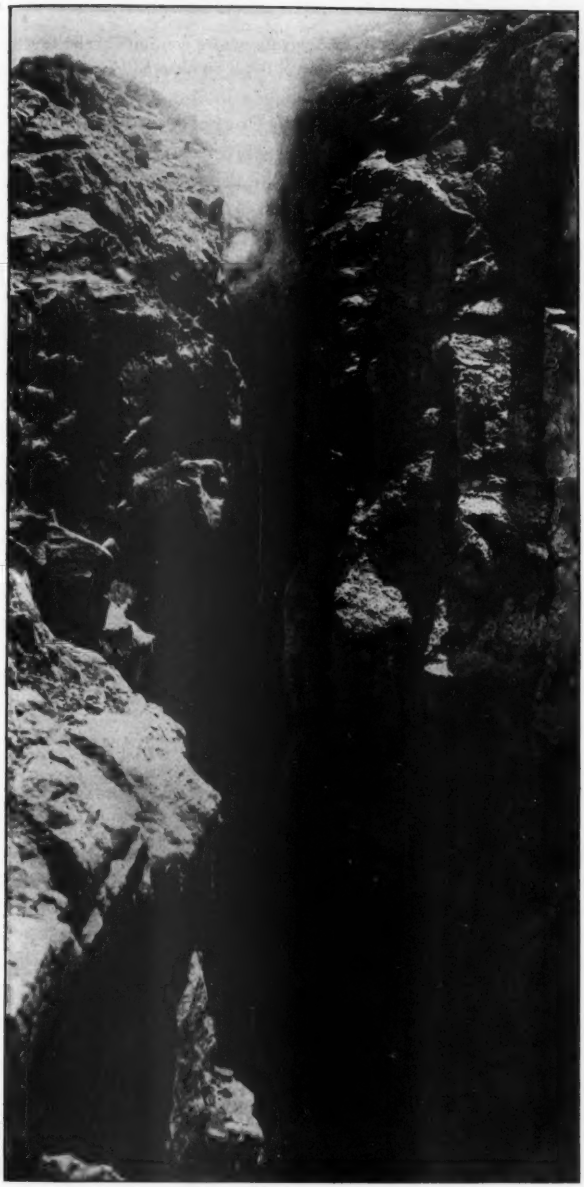


FIG. 7.

THE GRANDE SOUFRIÈRE. THE CRATÈRE DU NORD AND NORTHERN PORTION OF THE GRANDE FENTE. THIS IS THE MOST ACTIVE PORTION OF THE VOLCANO AND IS THE VENT FROM WHICH THE ERUPTION OF 1797 TOOK PLACE. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 17, 1903, BY E. O. HOVEY.

brated mountains of the island, which vomits smoke continually and to which there has been given on this account the name of the "Soulfrière." There are also springs of boiling water . . . .

The first eruption of the Grande Soufrière in historic times took place in September [1796?] 1797, after a series of earthquakes. Terrible rumblings were heard in the mountain, and a fine rain of cinders spread itself over the heights of Matouba, which lie northwest of the mountain. During this eruption the top of the Piton Breislach was broken off by the earthquakes and the Cratère du Nord came into activity. The next eruption, and the only other which has been recorded, occurred on December 3, 1836. This likewise was characterized by an abundant rain of cinders. It had the effect of extinguishing all the vents of the north and of concentrating the volcanic activity to the south and to the east. During this eruption, the Cratère Napoléon, which is the best-known of all the fumaroles of the Soufrière, came into existence.

Kingsley* states that "smoke by day and flame by night—or probably that light reflected from below, which is often mistaken for flame in volcanic eruptions—have been seen again and again above the craters." There seems, however, to be some doubt as to the accuracy of the statement that any incandescent matter has been visible in the mountain for many years; at any rate no mention of such a phenomenon was made to the author by MM. Thionville, Colardeau, and Le Boucher. On the slope of Morne l'Échelle, M. Thionville pointed out to the author a "bread-crust" bomb of pumice which apparently had come from some ancient eruption of the Soufrière. It was much decomposed, but its character was still plainly evident from the old densely-vitreous surface being preserved, and its appearance was that of many of the bombs thrown out by Mont Pelé in 1902. Other similar "bread-crust" bombs have been found near Basse Terre and elsewhere, photographs of two of which have been communicated by Dr. Colardeau. Many blocks of pumice lie upon the surface of the mountain slopes.

The great eruptions on Martinique and St. Vincent in 1902 naturally directed much attention to the Grande Soufrière of Guadeloupe, the more so on account of the fumarole area which has opened on the north flank of Morne l'Échelle in the valley between that peak and the cone of the Soufrière. The activity of this new area was first observed by Le Boucher in 1894. Since that time the activity has gradually increased and new vents have been opening in an irregularly oval area, the axis of which is about N.N.E.–

* "At Last." London, Macmillan, 1874, p. 39.

S.S.W. in direction. Early in 1898 the new fumaroles first became visible from Basse Terre, and even from Pointe-à-Pitre, and during the year the vegetation was destroyed over an area of rather more than an acre about the vents. The ground, too, became hot to the touch, and could not long be endured by the barefooted

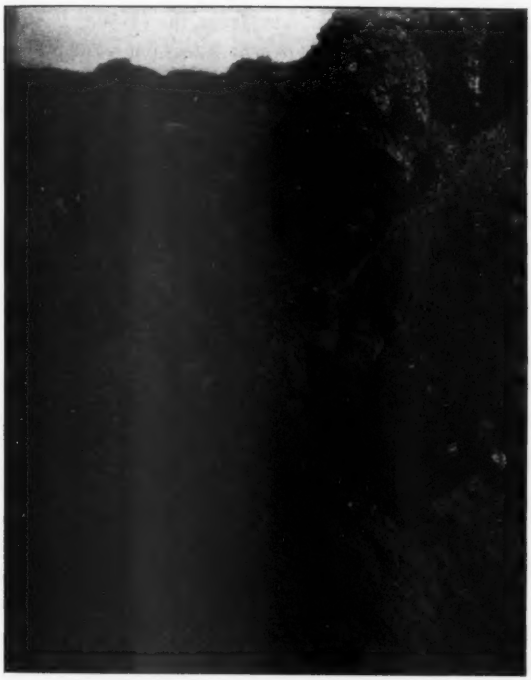


FIG. 8.
THE GRANDE SOUFRIÈRE. THE CRATÈRE DU SUD: SOUTHWESTERN PORTION OF THE INTERSECTING FISSURE. THIS NARROW CHASM IS SO DEEP THAT THE REVERBERATIONS OF A FALLING STONE ARE HEARD FOR FOURTEEN SECONDS. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 18, 1903, BY E. O. HOVEY.

guides. At the time of the author's visit to the region in April, 1903, the vegetation had been killed over a plot ten or twelve acres in extent.

There are many steam vents here, but their number and position change somewhat from time to time. Certain of them are "dry" vents—that is to say, nothing but steam issues from them; others are "wet" fumaroles—that is, the steam issues through a

spring of boiling mud similar in character to the "paint-pots" of the Yellowstone Park geyser region. The largest of these boiling mud springs were about six feet across in April, 1903, whereas they were only six inches in diameter when first noticed by M. Thionville six years before. From time to time the activity in these wet fumaroles increases sufficiently to throw the mud in geyser-like outbursts to a distance of a few feet from the orifice, but there is no regularity about the intervals at which this happens. The temperature observed April 17, 1903, was 96° C. in the largest of the wet fumaroles. Dr. Colardeau states that the temperature of the l'Échelle fumaroles rose to 110° C. by December 6, 1903, but that it diminished again to 103° C. in the following six months. The vapour issuing from the dry fumaroles apparently contains more sulphur than that from the wet. This seems to be in the form of hydrogen sulphide (H_2S), from which the sulphur deposits readily on leaves, twigs, and other objects in the form of minute crystals.

On the slopes of Morne l'Échelle, to the northeast of this fumarole area, a new series of vents was observed in the spring of 1903. These were steaming rather copiously at the time of the author's visit, as was also a still more recent vent in the middle of the east slope of the Grande Soufrière, but neither locality was visited for lack of time to cut a pathway through the dense growth of wild pineapple covering the mountain.

Between the western slopes of Morne l'Échelle and the base of the cone of the Grande Soufrière lies the gorge of the Matylys, which is the site of several cold, warm, and hot springs the water of which is more or less impregnated with sulphur and alum. The trail lies along this gorge, and is often rendered impassable by the torrents following the deluges which characterize the tropical showers in the mountains. Leaving the Matylys, the trail traverses the dense thickets of mountain mangrove at the southern base of the great cone. Here are to be seen the Sources du Galion, warm and hot sulphur springs discharging their waters into the Galion River, the torrential stream which reaches the sea near Basse Terre. The springs are eight in number, and they vary in temperature, according to Le Boucher, from 65° C. to 73° C. Each varies considerably, furthermore, from time to time. One spring, for instance, showed a temperature of 37° C. in the fall of 1889, 55° C. in 1893 and 73° C. in 1899. In general there has been a rising of temperature, but the increase has not been general or uniform. Many other warm and hot springs are known throughout the island of Basse Terre, indicating that the activity of the volcanic centres

of the island, though dying, is not altogether extinct, even aside from the Grande Soufrière and the immediate vicinity.

The increase in the activity which has been going on at the Soufrière of Guadeloupe for about ten years is a matter of serious concern to the inhabitants of the island, who are in constant dread lest their volcano should prove as disastrous a neighbour to them as Mont Pelé was to St. Pierre. It is impossible to predict the

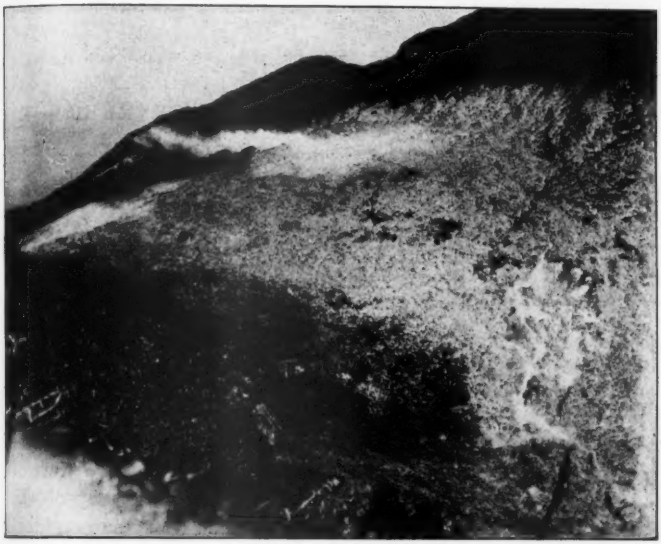


FIG. 9.
THE NEW FUMAROLE AREA ON THE NORTHERN SLOPE OF MORNE L'ECHELLE. HERE THE VEGETATION HAS BEEN DESTROYED OVER AN AREA OF TEN OR TWELVE ACRES BY THE FUMAROLES WHICH HAVE COME INTO ACTIVITY SINCE 1894.
PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 17, 1904, BY E. O. HOVEY.

future of a volcano about which so little is definitely known as the Soufrière of Guadeloupe. It is safe to say, however, that the increase of activity has been so gradual that there seems to be no imminent danger of an eruption, and that the present may be one of the periodic increases which have characterized the history of the volcano for generations. Furthermore, the configuration of the mountain is such that no blast could issue from it concentrated in a narrow zone in the manner that proved so destructive to St. Pierre. If an eruption should make use of the present fissures in the cone, the maximum violence would probably be exerted in a

northerly and southerly direction, so that the area of devastation would be an ellipse, the longer axis of which would be from north to south, and the phenomena would resemble those of the Soufrière of St. Vincent rather than of Mont Pelé. There would be danger of the destruction of Camp Jacob and the plantations along the middle slopes of the mountain, but the warnings of an imminent eruption would, perhaps, be heeded by the inhabitants, after the experience of the dwellers upon the slopes of Mont Pelé.

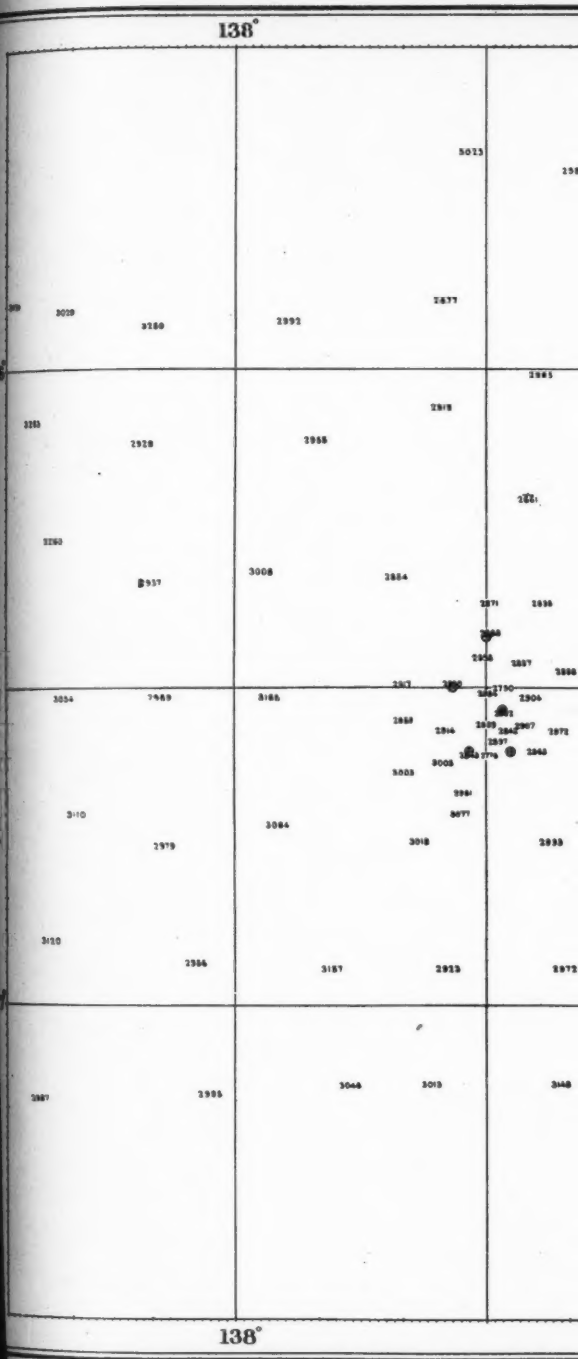
THE DISPROOF OF THE EXISTENCE OF REED OR REDFIELD ROCKS.

BY

G. W. LITTLEHALES.

For fifty years mariners continued to believe, or to be unable to disbelieve, in the existence of dangerous rocks in the Pacific Ocean, in a position about seven hundred miles westward of San Francisco. In 1850 Captain Reed, of the brig *Emma*, reported that he had seen two rocks, measuring from six hundred to nine hundred feet long, and from two hundred and fifty to four hundred feet broad, and having a depth of about three fathoms of water over them, in latitude 37° 24′ north and longitude 137° 22′ west of Greenwich; and in 1851 a report came from the U. S. sloop-of-war *Falmouth* confirming the existence of rocks in this geographical position. Captain Redfield, of the whaler *Susan Abigail*, also reported in 1856 that he had discovered some rocks, with about ten feet of water over them, in a geographical position eleven miles to the northward of the geographical position stated by Captain Reed; and in 1866 rocks were again said to have been seen by Captain Cave, whose report assigned to them a position one mile to the northward and five miles to the eastward of the geographical position agreed upon by the original authorities. Commander Franklin, of the U. S. S. *Mohican*, reported in 1870 that the office of the harbour-master at Honolulu contained records showing that the ships *Kuttosoff* and *Eliza Kimball* had found these rocks, which by that time had come to be known as Reed or Redfield Rocks, and that the latter ship had anchored in five fathoms of water there, and described three of the rocks as extending considerably above the surface of the water.

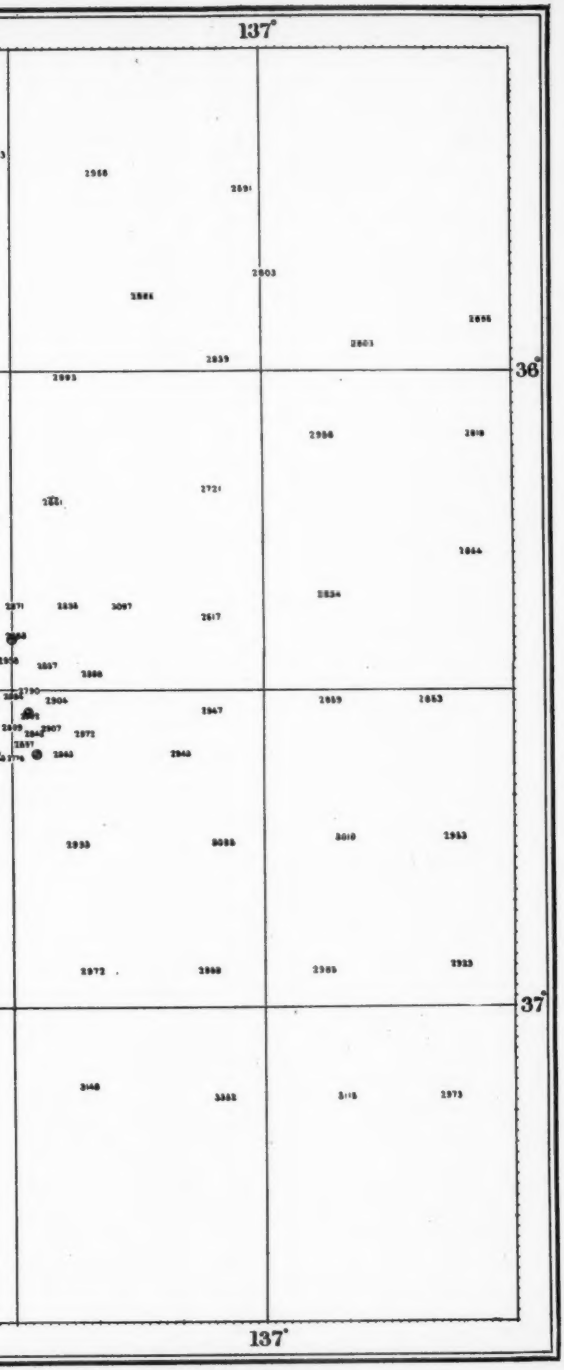
XUM



⊕ *Indicates the different reported positions of I*

DEEP-SEA SOUNDINGS BY THE U. S. SS. RANG

XUM



positions of Reed or Redfield Rocks.

E U. S. SS. RANGER AND WHEELING.

In the meantime the bark *What Cheer* had, in 1858, passed over the locality in which the rocks were reported to exist, and her master stated that he could discover no evidence of their existence, and in 1863 the master of the bark *Live Yankee* had made a similar report; and, although it was well understood, on account of the uncertainty in the reckoning of these vessels and the margin of error inherent in the positions assigned to the rocks, how slight a foundation these reports afforded in disproof of the existence of what had been seen by six apparently reliable and careful ship-masters, and by five of them examined and described, yet they served to stimulate investigation. So that in the years immediately afterwards we find that searches were made by the U. S. sloop-of-war *Kearsarge* in 1870, the U. S. Coast Survey schooner *Marcy* in 1871, the U. S. Coast Survey steamer *Hassler* in 1873, the U. S. S. *Narragansett* in 1875. All of them, however, employed the inconclusive method of proceeding to the reported locality of the rocks and cruising back and forth over the region, with look-outs posted aloft and a certain amount of deep-sea sounding-line hanging over the side of the ship. The four vessels just named must have spent altogether 31 days in this way, and the total distance which they cruised back and forth over the locality is about 2,800 miles.

The reconnaissance made by the *Kearsarge* took place on a beautifully clear day in September. The ship had proceeded from Honolulu, where the chronometers had been verified, and had every facility for determining the accuracy of her position in the field of search; but, although the range of view extended to a radius of ten miles around the ship as she steamed back and forth, visiting in turn each of the positions in which the rocks had been reported, the observed conditions did not reveal the slightest indications of the proximity of shoals or rocks, either by the breaking of the waves or by the presence of birds or fishes.

The examination made by the *Narragansett* took place on a day in June which was most favourable for the work, as the atmosphere was remarkably clear, and there was a heavy swell that would have caused the sea to break in a depth of five or six fathoms; but the lookouts that were posted aloft and on the deck of the vessel during the day's search could discover no indications of the reported danger.

In the search by the *Marcy* the surface conditions were examined in great detail from July 23 to August 5, under favourable circumstances of wind and weather, and with a swell large enough at all

times to cause the sea to break in a depth of three fathoms. During this search the distance run by the vessel was one thousand and fifty miles, of which seven hundred and seventy miles were made in daylight, when breakers or any discoloured water should have been visible within at least one mile. A constant lookout was maintained from the masthead, but no breakers were seen, nor any indications of shoal-water, such as the presence of gulls, seals, fish, or kelp. The water was uniformly of a deep blue, and at various places the deep-sea sounding-line was lowered to depths varying from three hundred to eighteen hundred fathoms without touching bottom.

The site of the reported dangers was again and still further examined between the 24th of May and the middle of June, 1873, by the U. S. Coast Survey steamer *Hassler*, but without finding any feature corresponding to Reed or Redfield Rocks. The steamer ran fourteen hundred miles in traversing the region in the vicinity of the reported geographical positions. Lookouts were constantly aloft, but no indications of shoal-water could be discovered.

It is plain that the force of the evidence in disproof of the existence of the Rocks, proceeding from these four searches, rested almost altogether upon the result that the observers did not see them; and it was not until the year 1881 that the first positive evidence was contributed toward the settlement of the question. In August of that year the U. S. S. *Ranger* sounded down to the bottom with pianoforte wire at thirty stations, whose geographical positions were accurately established within the area bounded by the parallels of 37° 20′ and 37° 40′ of north latitude and the meridians of 137° 20′ and 137° 40′ of west longitude. In the light of a mathematical investigation undertaken at the Hydrographic Office to determine the forms and dimensions of isolated submarine formations in the open ocean, these soundings afford positive proof of the absence of Reed or Redfield Rocks from the area which was sounded out.

Isolated formations occupying comparatively limited areas at the bottom can and do occur in deep waters. The minimum radius at the bottom which a dangerous shoal can have must vary directly with the depth of the surrounding sea, but, on the average, in a sea of 2,500 fathoms in depth, it may be stated as ten nautical miles. An interval of 10 miles coupled with an interval of 2 miles and employed systematically in sounding would be sufficient to prove the existence or absence of any formation rising close to the sur-

face. Of all the possible ways in which a 10-mile interval could lie with reference to a submerged peak, that which would be most advantageous for a prompt discovery of its existence is the condition in which one end of the interval is at the bottom of the slope and the other near the apex, and that which would be least advantageous is the condition in which the interval is bisected by the position of the apex. In the latter case there would be nearly equal soundings at both ends, but the soundings at the ends of the adjacent 2-mile intervals would immediately disclose the slopes.

Although the exhaustive examination made by the late Admiral Philip in the U. S. S. *Ranger* was conceded to have disproved the existence of Reed or Redfield Rocks within the area that was searched by him, a doubt remained, owing to the imperfect determination of the geographical position assigned, as to whether the rocks might not be within reasonable limits outside of the field of his inspection, notwithstanding the curious accordance among the reported positions, which only range seven minutes of arc in longitude and seventeen minutes in latitude; and this doubt was strengthened from time to time by the accounts of incoming mariners, who asserted that they had seen these dangers. In 1888 the master of the ship *British Yeoman* reported that he had seen these rocks in passing them; and in 1889 the master of the schooner *Una* reported that he had observed a peaked rock standing four feet above the surface of the sea in latitude 37° 24′ north and longitude 137° 26′ west, saying, "There is not any room for doubt as to this being a rock, but the position may vary a little on account of the sights not being extra good."

The whole question was finally set at rest in the early part of the year 1901, when the U. S. S. *Wheeling*, under instructions prepared by the Hydrographic Office, searched the area marked out by assigning extreme errors of ± 60′ in longitude and ± 40′ in latitude to the average of the reported geographical positions, by sounding down to the bottom of the ocean at intervals so closely spaced that no formation composed of the materials which constitute the earth's crust and shaped with sufficient strength to resist crushing under its own weight and the weight of the superincumbent body of water could rise from a depth of 2,600 to 3,000 fathoms to the surface of the ocean in the interval between any two of the sounding stations.

The area in the immediate vicinity of the reported geographical positions of the danger, bounded by the parallels of 37° 20′ and 37° 40′ of north latitude and the meridians of 137° 20′ and 137° 40′

of west longitude, which was searched by the U. S. S. *Ranger* in 1881, was not entered by the *Wheeling*. The *Ranger* obtained twenty-nine soundings, ranging in depth from 2,776 to 3,097 fathoms, and the *Wheeling* fifty-nine soundings, ranging in depth from 2,850 to 3,352 fathoms. Numerous specimens collected by both vessels indicated that throughout the combined extent of the searches there is a sameness in the characteristics of the bottom soil.

The accompanying chart of the soundings that were taken demonstrates that there is no submarine mountain culminating near the surface of the sea in this region, and shows with equal force that there never were any rocks here nor any shoal upon which a vessel could have anchored.

This is not a locality in which the floating things of the ocean are apt to collect, and it will perhaps ever remain a mystery as to what misleading appearances of the surface of the sea could have given rise to the reports which caused the representation for fifty years in the charts of all the great maritime nations of a dangerous feature which had no real existence.

GEOGRAPHICAL RECORD.

AMERICA.

Colossal Bridges of Utah.—The natural bridges described and illustrated by Mr. W. W. Dyar in the *Century Magazine* for August are believed to be unequalled by any known in other parts of the world. These bridges are near the head of White Cañon, in San Juan County, Utah. The rare phenomenon is here witnessed of erosive forces so balanced against the varying endurance of natural rock cliffs "as to excavate and undermine and leave intact a span of the firmer rock arching over an eroded softer stratum."

Mr. Dyar says that the walls and buttresses of the bridges are composed of pinkish sandstone, streaked here and there with green and orange-coloured moss or lichens. The Caroline bridge measures about 208½ feet from buttress to buttress across the bottom of the cañon. The centre of the arch is 197 feet above the water flowing beneath it. Above the highest point of the arch rises the solid mass of sandstone 125 feet higher to the level floor of the bridge. The causeway is thus 322 feet above the stream, and the floor of the bridge is 127 feet wide.

A still more remarkable and majestic sight is the Augusta bridge, three and a half miles above the Caroline bridge. Here the cross-section of the cañon is 335 feet 7 inches from wall to wall. The splendid arch is of sandstone, 60 feet thick in the central part, and 40 feet wide. The opening beneath the arch is 357 feet in perpendicular height. Some idea of its magnificent proportions may be gained by a few comparisons.

The bridge is twice as high, and its span is more than three times as great, as that of the famous Natural Bridge of Virginia. The bridge would overspan the Capitol at Washington and clear the top of the dome by 51 feet; and if the loftiest tree in the Calaveras grove of giant sequoias in California stood in the bottom of the cañon its topmost bough would lack 31 feet of reaching the under side of the arch.

The Little bridge, about a mile and a half below the Caroline bridge, is not so large as the other bridges, but is still a remarkably imposing object. These great natural curiosities were discovered by Emory Knowles in the summer of 1895, and seen by Mr. Scorup, a cattleman, in the fall of the same year. The photographs and the notes from which Mr. Dyar wrote his description were made by Mr. Horace J. Long, who, with Mr. Scorup, visited the bridges on March 13, 1903. The region abounds in the remains of cliff dwellers, and is apparently destined to become one of the show places of the country.

The Mountain Ranges of the Great Basin.—The geologists of the early surveys of the Great Basin reported the existence of fault block mountains so recently upturned that the evidence of the faulting is revealed in the topography, even though the fault-plane itself is hidden from view. Professor Davis has given the subject considerable attention in the past few years, and, as a result of his studies, has issued two or three papers discussing the physiographic evidence of fault origin. His last essay (Bull. Museum Comparative Zoology, XLII, 1903, 129–177) presents a thorough discussion of the topographic features to be expected in an uplifted faulted block in various stages of development. After having constructed a theory based upon this consideration, he describes the topographic characteristics of certain mountains of the Great Basin, which he has studied, and shows how closely they agree with the ideal forms which his theory calls for. By the aid of text, diagrams, and photographs he shows clearly that the phenomena presented by certain of the Great Basin mountains are clearly in accord with

the faulting hypothesis. His paper is an interesting illustration of the value of correct understanding of topography in interpreting geological history. Throughout the paper little use is made of stratigraphy, and no direct evidence of faulting is introduced, excepting that presented by alluvial deposits of recent age, which in some cases have been disturbed by recent movements along the fault-planes. R. S. T.

HANGING VALLEYS OF GEORGETOWN, COLORADO.—The presence of tributary valleys whose rock floors stand well above the level of a main valley bottom has now been recorded in numerous places; for example, Norway, the Alps, the Yosemite, and the Finger Lake region of Central New York. To explain these *hanging valleys* several essays have already been written, and the leading explanations offered have been: (1) down-faulting of the main valley floor, (2) lowering of the main valley floor by rapid river erosion, (3) lowering of the main valley by glacial erosion. The last explanation has recently received considerable attention as a result of the fact that it has been applied by Prof. Davis to the phenomenon as observed in the Alps and the valleys of the Norwegian fjords.

Since each of these three explanations is capable of accounting for the phenomenon of hanging valleys, it is evident that each case must be examined by itself in order to discover its cause. This has been done by Crosby (Technology Quarterly, Vol. XVI, 1903, pp. 41–50) for the very striking cases of hanging valleys near Georgetown, Colorado. That glacial erosion will not account for the facts is proved by the absence of all signs of glaciation in the main valley below the hanging valley. Certain facts of topography are deemed fatal to the theory of stream erosion. This, by elimination, leaves faulting as the only explanation possible; and Crosby shows that the mining operations have revealed an extensive system of faults, along some of which, moreover, there has been comparatively recent movement. His conclusion is, therefore, that the floor of the main valley at Georgetown is a downsunken block so recently lowered that the tributary valleys have been left hanging above it. R. S. T.

MR. ROBERT T. HILL'S WORK IN MEXICO.—This well-known geologist has recently returned from a long trip of exploration in Mexico. He has been studying that country for years with a view to obtaining information concerning its geological evolution and history and the relations with the geographical features of the United States on one side and Central America on the other.

In a paper which he presented to the Eighth International Geographic Congress on "The Physical Geography of Mexico," Mr. Hill showed that the plateau province, which embraces nine-tenths of the Republic and is its chief physical feature, is the southern continuation and end of the great North American Cordilleran system. Its relations, however, are not with the Pacific Mountains or the Rocky Mountain ranges, but it is the southern continuation of the Colorado Plateau, evolved by the folding and faulting of the latter to the southward. In common with the Colorado Plateau, it has been subjected to great uplift and subsidence. Mr. Hill is now writing a book on Mexico, in which he will describe at length the geological, topographical, and climatic features of the country and their relations to the cultural geography of Mexico.

The New Mexican Port of Salina Cruz.—President Diaz, in his Message to the Mexican Congress on April 2 last, spoke at length of the various public works in progress. The largest of these numerous enterprises is the creation of the port of Salina Cruz, on the Pacific side of the Isthmus of Tehuantepec. Three thousand workmen are employed there, and the improvement is now far advanced.

Salina Cruz has been nothing more than a dangerous roadstead, exposed to all the sea storms. The town was merely a miserable village of a tribe of Indians, who have now been removed a little into the interior. The building of a safe harbour has been a work of much difficulty. The harbour is formed by a breakwater 3,300 feet in length, built of great blocks of cement. Within the breakwater spacious docks are being constructed. The sea-floor of the harbour is being dredged so that the basin will accommodate the largest shipping, and a dry dock is being built in which two large vessels may be placed at once. It is expected that within about a year Salina Cruz will be transformed into a safe and, in all respects, an excellent port.

The Atlantic port of Coatzacoalcos, on the north side of the isthmus, was far less difficult to construct. The business part of this harbour will be chiefly along the Coatzacoalcos River, which is navigable for several miles from the sea, and is adapted for large wharfage accommodations. The depth of water alongside the wharves will be 35 feet at low tide.

Between these two ports the railroad, 192 miles across the isthmus, has been entirely rebuilt, and the completed track and bed are said to be in perfect condition. Mexico hopes to attract a large amount of world-trade across the isthmus upon completion

of these two ports. Arrangements are already far advanced for making the Isthmus of Tehuantepec the focus of important railroad lines.

BURIED ICE-SHEETS IN THE TUNDRA.— Many travellers have described the occurrence of sheets of clear ice in the alluvial deposits of Arctic America. In a recent number of the *Journal of Geology* (Vol. XII, 1904, pp. 232–236) Tyrrell describes these under the name *crystosphene*, giving numerous instances observed in the Yukon Territory, and discussing their origin. He states that, though the ground is permanently frozen to depths varying from 40 to 200 feet, there are, here and there, unfrozen channels through which springs rise, flowing without interruption throughout the year. These springs may be unnoticed in summer, but in winter, when the temperature may fall as low as—60° F., the spring water freezes around the spring, causing such a marked accumulation of ice that the name "glacier" is locally applied. In explanation of the crystosphenes, Tyrrell proposes the theory that they are related to this spring action when the spring water is prevented from rising to the surface. He states that the clear ice layers are more or less horizontal sheets of from six inches to three feet or more in thickness, lying between layers of muck and fine alluvium, usually where there are associated layers of silt or sand. Most of them are from two to four feet below the surface, and approximate closely to the slope of the surface under which they lie. The exact manner in which the spring water forms the crystosphenes is outlined as follows: The water of a spring of moderate volume, rising toward the surface, reaches a level near the surface where it freezes in winter, and continues to form downward as the winter cold increases. Reaching a plane of weakness, such as occur in horizontal beds, the water is forced along it, and, freezing, forms a horizontal bed whose thickness and areal extent will depend upon surroundings. The covering of moss or muck, being an excellent non-conductor, protects the crystosphene from melting in summer, and thus there is developed a permanent underground ice-sheet. R. S. T.

EUROPE.

REFORESTATION IN ICELAND.—Prof. C. V. Prytz, of Copenhagen, has recently visited Iceland to study the prospects of inducing a larger amount of tree growth there. His conclusions are summarized in *Globus* (No. 16, April, 1904). He says that a considerable part of the surface of Iceland was once covered with trees, which were finally killed out by reckless cutting and the browsing

of cattle and sheep on the very young timber. The result is that the fertile humus that had formed on tree-covered areas has disappeared, leaving only a stony surface. Woods, however, containing trees of considerable size still exist in various parts of the island, and the climatic conditions are not unfavourable to tree growth. Reforestation would not only supply the great desideratum of firewood, but would also help to protect the surface soil, and thus help to increase the adaptability of land for cultivation. Firs, pines, and birches would thrive in many situations, and Prof. Prytz thinks the experiment would be very successful. He recommends that trees be planted near the farms, where they may be protected from cattle, and that plantations be started on the slopes of the mountains.

Winning Land from the North Sea.—The Germans are now building a dam nearly three miles long to connect the Island of Nordstrand, west of the town of Husum, in Schleswig-Holstein, with the mainland. The top of this dam, which will be used as a highway, will be about two feet above high tide. The effect of the dam and of others already built or building between various islands and the mainland, further north, will be to prevent the rush of ebb and flow tide along the coast and the destruction caused by storm waves, sediment will be deposited in the comparatively quiet waters, and gradually new land will be formed between the islands and the coast. This great work of improvement is being carried out by the Prussian Government. It is expected that the protection of the coast thus secured will have the double advantage of keeping the sea from eating further into the mainland and of adding new areas of land to cultivation.

Sunshine and Influenza.—Recent studies of the duration of bright sunshine in Nuremberg, in relation to the number of cases of influenza there recorded, show that the disease is most common, not when there is the least amount of sunshine, as has been stated to be the rule in other places, but when there is a maximum of sunshine. Further, a long period of cloudy weather in Nuremberg is not, so far as these same observations go, accompanied by an excess of influenza. It is to be noted that the observations referred to and discussed in *Das Wetter* for April, 1904, cover a comparative short period (1898–1903), and, therefore, must not be taken as giving a definite answer to the question, especially as other factors, such as rainfall, humidity, wind, temperature, etc., as well as controls other than meteorological, doubtless play a part in the matter.

R. DeC. W.

Climatic Influence on Vineyards.—The disappearance of vineyards from southern England, where grapes used to be grown, has led to a belief in a change of climate in that region. In the *Quarterly Journal of the Royal Meteorological Society* for April, 1904, Mr. Richard Strachan has collected the data concerning the location and extent of the vineyards which were recorded at the time of William the Conqueror. These vineyards were maintained for about twelve centuries, but later the vine ceased to flourish there. Mr. Strachan believes it not improbable that a change of climate had something to do with these changes, the vineyard period having been marked by warm and sunny summers. It should be remembered in this connection that while many reasons have been brought up by various writers for believing in changes of climate, other writers have brought up other reasons, just as good, for believing that there has been no change. An examination of the records of temperature and of rainfall from the time at which such records were first kept brings to light no evidence of a progressive change in the temperature of the air, or in the amount of rainfall. In France, Angot has made a very careful study of the dates of the vintage since the fourteenth century, and finds no evidence of a progressive change in the climate. It is unsafe to argue in favour of climatic change on the basis of such data as those collected by Mr. Strachan. The simple fact that grapes could be grown more profitably on the Continent would be a sufficient reason for the abandonment of the English vineyards. R. DeC. W.

AFRICA.

Railroad Development in Africa.—Five years ago there were less than 9,000 miles of completed railroad in Africa; to-day there are 13,000 miles. Very little of this railroad development in the past few years has been in civilized lands, like Algeria and Tunis, Egypt, Cape Colony, and Natal, which are fairly well supplied; but the tracks have been extending through the jungles, forests, and deserts of the tropical colonies. In 1899 the length of these colonial railroads was only 1,226 miles; to-day there are 4,475 miles of colonial railroads in operation, and thousands of native labourers are at work on over 1,700 miles, which will probably be added to the completed mileage within another year. The prospects are that within the next six years there will be 25,000 miles of railroads in Africa.

Not only in railroad-building, but also in all other industrial enterprises throughout Africa, the barbarous native is the instru-

ment employed under white guidance in the colossal task of development. On the whole he is doing his part well.

All sorts of gauges are being used in building these railroads, and most of them are narrow gauge. This is not the case, however, in South Africa. The Beira Railroad, when first built, was narrow gauge; but it was converted later to standard gauge, to conform with the Cape roads, and there is now a uniformity of gauge throughout South Africa.

The following table gives a summary to this time of the colonial railroads that have been built and those that are now in course of construction:

	BUILT. MILES.	BUILDING. MILES.
GERMAN COLONIES.		
Tanga-Mombo	80	..
Swakopmund-Windhoek	237	..
Lome-Little Popo	..	26
Total	317	26
FRENCH COLONIES.		
St. Louis-Dakar	164	..
Kayes-Bamako	345	..
Konakry-Kurussa	99	322
Bingerville-Kuadikosi	..	164
Kotonu-Tshauru	55	379
Pahu-Wyda	9	..
Jibutil-Harar	185	..
Brekaville-Tananarivo	116	130
Total	973	995
ENGLISH COLONIES.		
Freetown-Bo	135	..
Sekondi-Kumassi	179	..
Accra-Kpong	..	62
Lagos-Ibadan	125	..
Zungeru-Barijugo	28	..
Menini-Salisbury	170	..
Salisbury-Bulawayo	300	..
Bulawayo-Victoria Falls	278	..
Bulawayo-Gwanda	..	104
Gwelo-Selukwe	..	22
Chiromo-Nyassa	..	186
Mombasa-Victoria Nyanza	584	..
Total	1,799	374

	BUILT. MILES.	BUILDING. MILES.
CONGO FREE STATE.		
Matadi-Leopoldville	250	..
Bomar-Mayumbe	50	19
Stanleyville-Ponthierville	..	42
Total	300	61
PORTUGUESE COLONIES.		
Loanda-Lucalla River	225	..
Benguella-Catumbela	14	..
Beira-Menini	222	..
Total	461	.
ERITREA (ITALIAN).		
Massawa-Guinda	48	..
ANGLO-EGYPTIAN-SUDAN.		
Wadi-Halfa-Khartum	577	..
Berber-Suakin	..	250
Total	577	250
Grand total	4,475	1,706

CLIMBING THE RUWENZORI RANGE.—In a paper on "Western Uganda" (*Geog. Jour.*, Sept., 1904), the Rev. A. B. Fisher, who, with his wife, has ascended to the glaciers of the east side of the Ruwenzori Range, says that during their ascent the thermometer fell between the altitudes of 5,000 and 13,800 feet from 115° to 28° Fahr. He agrees with Sir Harry Johnston that the height of the highest peak is between 20,000 and 22,000 feet. The ascent to the snow-line is arduous, takes five days, and involves considerable danger. The ascent for 8,000 feet is over forest-clad ridges. Ferns of every variety are found, and maidenhair shrubs, enormous lobelias, and orchids are the predominant plants. Above 8,000 feet bird and insect life apparently ceases, and the silence is unbroken, except by the roar of glacier streams. Still higher stretch bamboo forests, terminating in thick morass and swamp that are fed by streams from the precipitous rocks above. The climbing is very steep to the foot of the glaciers. The highest points have not yet been attained, and Mr. Fisher is of the opinion that the range may be more successfully attacked from the western slopes. Thus far the ascents have been made on the eastern side.

South African Rainfall.—J. R. Sutton, meteorologist of the De Beers Consolidated Mines at Kimberley, has been giving much attention to a study of the climate of South Africa, and before the South African Philosophical Society, at a recent meeting, he read a paper entitled "An Introduction to the Study of South African Rainfall." This paper is the fifth of a series planned some years ago to describe the meteorology of the South African tableland in a form suited to the requirements of the physicist. It gives a history of Kimberley rainfall from 1877 to 1902, and discusses the annual, monthly, daily, and hourly values. The maximum known annual fall at Kimberley was 34.25 ins., in 1891; and the minimum was 8.75 ins., in 1897. This range is less than that of places similarly situated in Australia and India, but greater than that of South America. The wettest time of the year is the last week of February, and the driest is the first week of August. The position of Kimberley in the general scheme of South African rainfall is considered by comparing the rainfall of 160 stations in the country having records of 15 to 20 years or so. Monthly and annual averages are determined for these, both for the separate stations and also for the various areas into which the Meteorological Commission has divided South Africa. Rain on the central tableland comes chiefly with a northeast wind and a falling barometer; on the coast of Natal with a southwest wind and a rising barometer. In this and other respects there is scarcely any special agreement between the rain conditions of the two areas. The author's conclusion is that the rain of central South Africa originates in the main in the doldrums, being reinforced more or less by the moisture evaporated from the Indian Ocean; and that the aridity of the west coast is not caused, as Buchan asserts, by the southern anticyclonic belt, but simply by the coldness of the water.

R. DeC. W.

Transvaal Meteorological Service.—Considerable interest attaches to the work of the new Meteorological Service of the Transvaal, of which the director, Mr. R. T. A. Innes, contributes an account to *Symons's Meteorological Magazine* for May, 1904. The Transvaal Government decided to establish a Meteorological Department in November, 1902, and the director entered upon his duties in April, 1903. A site for a central observatory was secured on a range of hills three miles northeast of Johannesburg, the ground being partly purchased, but more largely presented, by a Dutch family—the Bezuidenhouts. The observatory is now built, and stands about 5,900 feet above sea-level. There are now in opera-

tion 200 rainfall stations, and about 30 second and third order stations. The observers are all voluntary, many of them being farmers and school teachers. Some twenty-five of the observers send daily weather telegrams to headquarters. Daily telegrams are also exchanged with Cape Town, Durban, Bloemfontein, and Salisbury, and on the basis of these telegrams a weather report is issued every day at noon. It was hoped that a set of self-recording instruments would be in working order at the central observatory by July 1st of this year. R. DEC. W.

ASIA.

TOPOGRAPHICAL SURVEYS OF CEYLON.—The report of the Surveyor-General of Ceylon for 1902 has a map showing that the topographical survey of the island is drawing to a close, the whole of the north, north-central, and east parts of the island having been surveyed and mapped since 1897. The work of 1902 filled in all the larger gaps. Fifteen thousand square miles have been mapped, on a scale of one inch to a mile, and about 2,000 on a scale of ten inches to a mile. The ten inches to the mile sheets show all forests, fields, gardens, etc. Up to the present time all maps of Ceylon have been very inaccurate, but the completion of the survey will make adequate maps possible.

POLYNESIA AND AUSTRALIA.

MARCUS ISLAND.—This speck of land has recently come into the possession of the United States, though until lately its exact position, and even its existence, were in doubt. It was marked with an interrogation point in *Stieler's Hand Atlas* in 1896, but receives an assured position in the edition of 1904.

A few years ago an American guano company began operations at the island, with the result that the United States and Japan became involved in a dispute as to its ownership. The dispute was settled in favour of our country.

One of the company's ships, in 1902, took out a scientific man from the Bishop Museum, Honolulu, to observe the geology, zoology, and botany of this hitherto unexplored spot. This gentleman, Mr. W. A. Bryan, was able to spend only a week on the island, but this was long enough to gain a general idea of its geographical history and surface features. His report has been printed in the "Occasional Papers" of the Museum.

The centre of the island is in 24° 14′ N., 154° E. Guam, about 1,000 miles to the southwest, is the nearest American land to it.

Though its position was ascertained during the voyage of the *Tuscarora* in 1874, it has often been confused with other rocks or islets in this part of the Pacific. It is still uncertain what other bits of land may exist in its neighbourhood, but from the flight of birds Mr. Bryan inferred that land would be found from 50 to 75 miles northeast of Marcus.

The island is roughly triangular in shape, its longest side measuring less than two miles. The highest points are near the angles, and the maximum elevation of 75 feet is near the north end. The island is an ancient atoll that has since been elevated so that the the bottom of its lagoon is now above the level of the sea. The shores are formed of coral sands and shingle, with huge blocks of coral rock, many of them at a considerable elevation above the sea. The interior surface consists partly of similar materials and partly of sand, more or less mixed with humus. Most of the island is thickly wooded. Storms have also helped to build up the island. Some sea or shore birds are abundant, but any terrestrial or arboreal birds that might have been accidentally introduced would have perished for want of suitable food.

Glaciation of Tasmania.—That local valley glaciers formerly existed in the mountains of Tasmania, where none now exist, has been fairly well established by previous workers; and the existence of glaciation during the Carboniferous Period rests upon evidence that seems difficult to deny. But the report that glacial deposits occur at a distance from the mountains, indicating extensive Pleistocene glaciations, has been denied by later workers whose knowledge of glacial deposits gives great weight to their opinions. Recently Prof. J. W. Gregory (*Quart. Jour. Geol. Soc.*, LX, 1904, 37–53) has published a paper reviewing the literature relative to the glaciation of Tasmania and adding a description of his own observations on the subject. He finds boulder clay, scratched stones, transported boulders, moraines, and other glacial deposits, proving conclusively that glaciers had reached well beyond the mountains and to levels of 400 feet above present sea-level. The condition of preservation of the glacial forms, and the freshness of the boulders and clays, indicate recent origin; in fact, Gregory says from their appearance they might be as recent as some of the later moraines of the North of England. This paper of Gregory's is of especial importance because of the fact that the conditions of glaciation in the southern hemisphere are only obscurely understood.

R. S. T.

POLAR.

SUMMING UP THE WORK OF THE BRITISH ANTARCTIC EXPEDITION.—The sledge expeditions of the *Discovery* party, during their second summer at Victoria Land, made a large addition to geographical knowledge. They confirmed the conclusion previously reached that the whole of the great journey made to the farthest south by Capt. Scott, in the previous year, was on sea ice (BULLETIN, May, 1904, p. 295).

The summit of the interior of Victoria Land was shown to be a great plain, reaching a height of nearly 9,000 feet. Capt. Scott is of the opinion (*Geog. Jour.*, July, 1904) that although the differences in level are slight, yet the ground is lower to the north and higher to the south, reckoning from the latitude in which the exploration was carried on—viz., 77° 59′ S. Lat.

The wind over the interior seems to be continuously westward. In winter it blows apparently with great violence from the west-south-west; while in summer it gradually shifts to southwest and south. The only snowfall of the year occurs during this period, and it seems to be extremely small.

In the great plain are slight undulations, which can only be detected by differences of shade in the snow or by a levelled theodolite. The greatest difference in level seems to be only from 50 to 60 feet, and this inclination is spread from two to three miles, so that it cannot be detected under foot.

The coast-line of Victoria Land is broken up by large fiords, which have been carefully mapped. The explorations of this expedition extended east and west over about one-sixth of the circumference of the Antarctic region in Lat. 78° S. The farthest reached to the east was off King Edward VII. Land in Long. 152° 30′ W.; while the farthest point to the west was Long. 146° 30′ E., attained by Capt. Scott and his party on their great journey.

THE COLDEST REGION OF THE EARTH.—The district around the Siberian town of Verkhoyansk, with a record of low temperature of −69.8 F., has long been regarded as the coldest region of the earth. According to the reports of the Russian Arctic painter Borissoff, some parts of Novaya Zemlia are subject to at least an equal degree of winter cold, and this region has recently been regarded as a second pole of greatest cold. During his latest visit to Novaya Zemlia he found near Matochkin-Shar, which separates the two large islands, a box containing a maximum and a minimum thermometer. The instruments were of Austrian manu-

facture, and were probably the property of the geologist Hofer, who visited that region in 1872. According to the readings of these instruments, the greatest warmth was 15° above and the greatest cold 70° F. below zero. The winter cold of Verkhoyansk appears thus to have been surpassed by that of the middle part of Novaya Zemlia (*Mitt. der Kais. Königl. Geog. Gesell. in Wien*, Vol. XLVII, Nos. 5 and 6).

ANTARCTIC METEOROLOGY.—In the *Scottish Geographical Magazine* (Vol. XX, 1904, pp. 113–120), R. C. Mossman, the meteorologist of the *Scotia* expedition, has recently published a summary of the results obtained during the voyage. The observations made by the *Scotia* expedition gain greatly in value from the fact that they may be compared with those of the Swedish expedition. It may also be recalled that the *Scotia's* station on the South Orkneys is to be continued by the Argentine Government, so that the preliminary observations made during the expedition itself will really form part of what is likely to be a long series. Mr. Mossman's account gives an abstract of the hourly meteorological observations made in Weddell Sea and at Scotia Bay, Laurie Island, South Orkneys, from February to October, 1903, and also gives some comparison with the observations made by Ross in approximately the same region at the same season in 1843. During the period of observation in the South Orkneys the coldest day (September 2) had a mean of −21.8°. The variability of the temperature was notable, the range on many days exceeding 50°, and on a few occasions 60°, the variations being due to the passage of rapidly-moving depressions, with sudden changes of wind from northwest to southwest. Foehn winds were recorded on several occasions, the winds being west-northwest, and the temperatures rising to 46.8° on one occasion. The wind from this direction had to pass over a considerable extent of high land before leaving Scotia Bay, and this gave opportunity for adiabatic warming during its descent. Winds from the northwest were most frequent (*i. e.*, the prevailing westerlies). Easterly winds were very rare, but in summer they are probably more frequent. In 1872, Neumayer put the limit of the "brave west winds" at about Lat. 62° S., and the results from the South Orkneys, situated a degree farther north, agree with this view.

R. DEC. W.

GENERAL.

THE POPULATION OF THE WORLD.—In No. XII of "Die Bevölkerung der Erde" (Ergänzungsheft No. 146 to *Pet. Mitt.*), Dr. Supan

gives the results of the latest censuses and estimates concerning the population of America, Africa, and the Polar lands, the changes of figures in parts of Europe that have affected the European total, together with the latest results in Asia, Australia, and New Zealand. He then sums up his estimates of the population of the world in the following table:

	Total Population.	Per Square Mile.
Europe	392,264,000	104
Asia	819,556,000	46.6
Africa	140,700,000	13
Australia and Polynesia	6,483,000	2
North America	105,714,000	13
South America	38,482,000	5
Polar Lands	91,000	—
Total	1,503,300,000*	30.6

Helps in the Study of Anthropogeography.—Among the most recent contributions of Dr. Ernst Friedrich, of Leipzig, to the study of man in his geographical relations are two that will be welcomed as facilitating the labours of students in this field. One of them is "Die Fortschritte der Anthropogeographie" (1891–1902), which is printed in the *Geographisches Jahrbuch* (Vol. XXVI) for 1903. In 37 pages Dr. Friedrich presents practically an exhaustive list of the literary production in this department of geography for the twelve years ending with 1902, giving with nearly every title a little explanatory or critical comment. A large part of the value of such a compilation lies in the division of the matter into groups and under the groups into topics, so that the student may find the literature dealing with just the phases of anthropogeography which he has under consideration. There is nothing lacking in the scientific arrangement of the literature which Dr. Friedrich records. His citations are not confined merely to entire works, but parts of works dealing with particular phases of the subject are referred to under the proper classification. The author divides his material into six main groups with a considerable number of subdivisions under each head. The groups are: I—Allgemeine Werke und Arbeiten; II—Der Boden (das Land) und der Mensch; III—Das Wasser und der Mensch; IV—Die Lufthülle und der Mensch; V—Pflanzen und Tiere und der Mensch; VI—Der Mensch und die Natur. The work is the most

* So printed in the Ergänzungsheft, but the correct addition is 1,503,290,000.

complete index that has yet appeared to the literature relating to this comparatively new branch of geographical study.

The latest monograph from the pen of Dr. Friedrich is "Die Entwickelung des Pflanzenbaues," one of the twenty-six papers prepared by old pupils of the late Friedrich Ratzel in honour of his sixtieth birthday. The paper is especially rich in facts drawn from all ages and all countries illustrating the development and progress of plant cultivation.

BIBLIOTHECA GEOGRAPHICA FOR 1900.—This is the ninth volume of a very useful annual. The volumes have presented classified lists of the world's geographical literature from 1891 to 1900, inclusive, and the ninth volume thus completes the first decade of the most comprehensive geographical index published. The plan of the book was so well laid out in the beginning that it has not been changed in any respect, but the volume has grown in pages every year. The present volume has 510 pages, of which about 15 are given to the United States and Alaska.

PERSONAL.

Prof. J. W. Gregory, the explorer of Mount Kenia, Africa, and for several years Professor of Geology in the University of Melbourne, has returned to Great Britain, to fill the same Chair in the University of Glasgow.

Dr. Julius Hann, Professor of Meteorology at the University of Vienna, has been elected an honorary member of the Russian Geographical Society.

Dr. F. J. H. Merrill has retired from the position of State Geologist of New York, and has opened an office in New York City for the practice of economic geology. Dr. John M. Clarke has succeeded Dr. Merrill at Albany.

Captain R. F. Scott, Leader of the British National Antarctic Expedition, has received the award of the Elisha Kent Kane Medal of the Geographical Society of Philadelphia.

XUM

TRIBUTES TO FRIEDRICH RATZEL.

On the ninth of August the telegraph announced to the scientific world the sad news of the death of Friedrich Ratzel, the geographer of the University of Leipzig.

One of the most productive investigators, one of the most inspiring teachers, of our science has passed away with him, and the story of his life is one of the few true stories of a genius finding his way in spite of circumstances which seemed to lead to quite a different end. He was born at Karlsruhe, Baden, and educated to be a pharmacist. But he soon found out that he wanted a deeper knowledge of nature than that secured in this profession, and, while serving his apprenticeship, spent his leisure hours in preparing for the examination that should admit him to the University. He was successful, and at Heidelberg, Jena, Berlin, Cette, and Montpellier studied zoology with the prominent teachers of that science, taking his doctor's degree at old Heidelberg. A series of zoological sketches published during his stay in Southern France established his relations to the Cologne *Gazette*, and as correspondent of that paper he first became a traveller, visiting the countries of Southern Europe until the Franco-German war called him back to serve his country. On his return from the battlefield he went to Munich to study geology and geography, and from there set out on new travels to the United States, Mexico, and Cuba. These are the travels to which we owe

FRIEDRICH RATZEL.

his valuable publications on America and American conditions, culminating in the "Geography of the United States," the best work on this country written by a foreigner, and whose second volume has recently been republished as the "Political Geography of the United States."

It was during those years that the transition from the naturalist to the geographer seems to have become manifest, so that when he returned he settled at Munich as a private docent of geography at the Institute of Technology of that city. He was soon promoted to a full professorship, which he held until called to Leipzig as Richthofen's successor in 1886.

It has been a most fortunate circumstance for the development of geography that it should have had within the same generation two such leaders as Richthofen and Ratzel—the one to revise the geography of the earth; the other, that of man. While the former availed himself of the methods of geology to put geography on a scientific basis, Ratzel took hold of the awakening of the historical and political sciences to the consciousness of the laws of nature underlying their progress in order to establish what is now recognized in the geographic world as *Anthropogeography*. The two volumes bearing this title—the famous *Ethnology*, the *Political Geography*, and, finally, *Earth and Life*—all tell the great story of the dependence of man upon the soil, of the interdependence of geography, history, and sociology. We need not dwell here on the revolution brought about by these books in the geographic world; we all have lived through part of it. But what ought to be emphasized over and over again in any appreciation of Ratzel's work is that he never, like the school of Ritter, whose successor he is to a certain extent, over-estimated this special phase of the science. He was as far from making geography the handmaid of history as he was from considering it only as a branch of the natural sciences. In all his works he reminds us over and over again of the Janus-like doublefacedness of geography, and his interest in physiographic problems was just as intense as that in the geography of man. The study of glaciers and névé in the Alps was a specialty of his from the earliest times to the last, and his investigations on snow-lines have been epoch-making for that study. He was one of the first to take up Chamberlin's new theories in a German university course, and one of his last studies deals with the scientific problems in scenology. He often reminds one of Humboldt in the universality of his interests and information.

No wonder, then, that he should have been one of the most in-

spiring teachers, especially for mature students. Exacting he was, to be sure, and his favour was not to be gained by the faultless recitation of paragraphs of a text-book or note-book. Himself an indefatigable worker, he required the highest effort also from his students. But whoever gave proof that he had really come to work found in him the most kind, helpful, inspiring friend from that minute on forever afterwards. In his room at the Geographic Seminar he was accessible to everybody, and, no matter how busy he was, his cordial handshake was always the same, his advice always as cheerfully given as if nothing else were more important than the matter just brought before him. It seemed as if, remembering the difficulties of his own youth, he had made it the purpose of his life to help those who were fighting a struggle similar to the one he had fought. "I am thankful to every diligent student," he once wrote to a former pupil, "who gives me his confidence and enables me to impart from my experience. I WANT TO BE MORE THAN A WALKING CYCLOPEDIA OR COLLECTION OF EXERCISES." He never coveted popularity; yet his lectures became more popular from year to year. When he founded the Geographic Seminar, it was started with accommodations for 16 members; it had 130 members at the time of his death.

The untimeliness of his death makes his loss still greater than it would have been in any case; those who have watched the trend of his work during the last few years know that it will be an irreparable loss to geography to be bereft of what he would still have given us had he reached the term of life set by the Psalmist. It has often been asked why it was that, with all his new ideas, Ratzel had not established a regular school of geographers, such as Ritter's or Richthofen's. This is partly due to the fact that the majority of geography students at Leipzig are prospective teachers, who, in their professional work, have little leisure to go on with independent research beyond the work of their doctor's theses; partly to this, that Ratzel himself did not care so very much to reduce his teachings to such convenient formulas, such a precise system of axioms, upon which a regular school can be established. He had not yet arrived at the point where a man draws up the results of a life's work. He sowed his seed liberally for the use of any one who would take care of it; he did not concern himself so much about planting it in regular furrows. That part of the work he left to his later years, or to those who would come after him. His "Earth and Life" seems to have been the first attempt in this direction; unfortunately enough, it will remain his only one. It

will be the most sacred duty of those who call themselves his followers to take care of this precious legacy. This will be the most appropriate tribute to the memory of the great master whose work has been an inspiration to the whole geographical world, and who, like Humboldt and Ritter, will always be remembered as one of the pathfinders and classic authors of our science.

MARTHA KRUG GENTHE.

Professor Friedrich Ratzel, who died in Germany on August 9th, was perhaps the most eminent geographer of Europe. His great achievement was in anthropogeography, which he was the first to raise to the rank of a science, based upon close inductive reasoning from an extensive body of facts. Ratzel had his forerunners in Buckle, Ritter, Peschel, and others, but their conclusions lacked the solid foundation as well as the completeness which characterizes Ratzel's work. Therefore his name will always be associated with the science of anthropogeography, as Adam Smith's is with that of political economy.

Though Ratzel had to his credit a long series of books dealing with his specialty, and by thirty years of research and literary activity had almost, single-handed, worked out a remarkably complete body of scientific principles, those who knew the youthful spirit of the man, his capacity for intellectual expansion, and his far-reaching plans of investigation feel that he still had large contributions to make to the science of anthropogeography.

Ratzel died when yet in his prime. He would have reached his sixtieth birthday on August 28th—a day for which his students at the University of Leipzig had planned an elaborate celebration. A man of vigorous and commanding appearance, he combined many lovable human qualities with his brilliant intellect, and he showed always a certain open-mindedness which made him in the eyes of his pupils the highest type of the scientist.

In his early manhood Ratzel travelled extensively in America, and afterwards wrote two comprehensive treatises on the geography of the United States and of Mexico.

ELLEN CHURCHILL SEMPLE
(Seaside House, Atlantic City).

NEW MAPS.

AMERICA.

UNITED STATES.—Geologic Atlas of the United States.

No. 101. San Luis Folio. California. Area, 974 square miles. Between parallels 35° and 35° 30′ N. Lat. and meridians 120° 30′ and 121° W. Long. Lies within the Coast Ranges, excepting in the west, the line of the Pacific coast extending diagonally across the quadrangle. The San Luis, Santa Lucia, and San José extend across the quadrangle, the Santa Lucia being the dominant mountain block. Two sheets of views show the high rugged coasts, prominent buttes among the mountains, and other aspects of the region.

No. 103. Nampa Folio. Idaho–Oregon. Area, 863.82 square miles. Between parallels 43° 30′ and 44° N. Lat. and meridians 116° 30′ and 117° W. Long. The quadrangle is in the lower part of the Snake River Valley, and is chiefly sagebrush desert, the irrigated lands, however, yielding good crops. The water flowing through the quadrangle is more than sufficient to irrigate the whole of it.

No. 106. Mount Stuart Folio. Washington. Area, 812.4 square miles. Between parallels 47° and 47° 30′ and meridians 120° 30′ and 121° W. Long. In the centre of the State, on the eastern slope of the Cascades. It contains both the oldest and the youngest rocks thus far discovered in the northern Cascades, and is thus a representative area for the geological province of which it is a part.

No. 107. Newcastle Folio. Wyoming–South Dakota. Area, 864 square miles. Between parallels 43° 30′ and 44° N. Lat. and meridians 104° and 104° 30′ W. Long. Being a part of the Great Plains and the Black Hills, it represents many features of both. One sheet shows the areas yielding artesian waters at various depths; another gives views of characteristic fossils, typical cliffs, the Cambria coal mine, etc.

No. 108. Edgemont Folio. South Dakota–Nebraska. Area, 871 square miles. Between parallels 43° and 43° 30′ N. Lat. and meridians 103° 30′ and 104° W. Long. Also a part of the Black Hills and Great Plains. Includes an artesian water-sheet, and illustrations showing geological formations, fossils, and topography.

No. 109. Cottonwood Falls Folio. Kansas. Area, 938 square miles. Between parallels 38° and 38° 30′ N. Lat. and meridians 96° 30′ and 97° W. Long. Within the limits of the Great Plains. The topographic forms are the result of erosive agencies acting on slightly-tilted sedimentary rocks.

UNITED STATES.—A Geological Map of Alabama. Scale not given. By Eugene A. Smith, State Geologist. Montgomery, Ala., 1904.

Six colours are used to show the geological formations, and various symbols are imposed on the colours to show the economic minerals found in each formation. The scale is small, but the map is excellent, and its information is clearly conveyed. The map accompanies an "Index to the Mineral Resources of Alabama," issued by the Geological Survey of the State.

UNITED STATES.—General Chart of Alaska. Scale, 1:2,534,400, or 40 statute miles to an inch. To accompany Reindeer Report for 1904. From Post Route Map issued by the P. O. Department, Washington, 1904.

This map will be very useful to all who are studying the development of Alaska.

It shows the situation of all the reindeer stations, public schools, and missions in the Territory.

UNITED STATES.—Geological Map of Indiana. Scale, 1:260,000, or 4 statute miles to an inch. Compiled by T. C. Hopkins. Department of Geology and Natural Resources, Indianapolis, 1904.

Colours are used to show the geological formations. The petroleum-producing areas are outlined, and the geological delineation is based upon field work during the years 1895–1903. The map accompanies the 28th Annual Report of the Department of Geology and Natural Resources of Indiana.

CANADA.—Railways in Manitoba, Assiniboia, Alberta, and Saskatchewan. Scale, 1:2,217,600, or 35 statute miles to an inch. Department of the Interior, Ottawa, 1904.

Shows the railways completed or building, with all their stations. As these data are laid down on the Land Office subdivision of the public lands, the relation of each section of land to transportation facilities is easily perceived.

CANADA.—Map showing Mounted Police Stations in North-Western Canada. Scale, 1:2,217,600, or 35 statute miles to an inch. Published by the authority of the President of the Privy Council, Ottawa, 1904.

The most northern of these stations is at Herschell Island, an Arctic whaling rendezvous near the border of Alaska. There are only four of them north of the sixtieth parallel, excepting in the Yukon mining region and its Canadian approach *via* the Whitehorse-Dawson road, where they are numerous. A table of distances is given from Athabaska Landing to many more northerly points.

CANADA.—Map showing Mounted Police Stations in the North West Territories. Scale, 1,792,000, or 12.5 miles to an inch. Published by the authority of the President of the Privy Council, Ottawa, 1904.

The map also shows the Indian Reservations, with their population, the trails, railroads, and telegraph lines.

CANADA.—Standard Topographical Map (Windsor Sheet). Scale, 1:250,000, or 3.95 statute miles to an inch. Department of the Interior, Ottawa, 1904.

CHILE.—Isla de Mocha. Scale, 1:40,000, or .6 of a statute mile to an inch. Chilian Government, Santiago, 1903.

A topographic map of the island, which is off the coast of Chile in 38°19′ S. Lat. The map accompanies an exhaustive monograph.

ASIA.

JAPAN, COREA, AND EASTERN CHINA.—Carta della Cina Orientale, Corea, Giappone ed Estremo Oriente Russo. Scale, 1:2,800,000, or 44.19 statute miles to an inch. Istituto Cartografico Italiano, Rome, no date. Price, LI.20.

The map shows the seat of the war in the far east and the adjacent regions. Though the scale is considerably larger than that of most atlases, not half the place-names clearly shown in the best atlases are given. The treaty ports are shown, but none of the Japanese naval stations is indicated as such, and the names of some of them do not appear. The best feature of the map is that the main lines of railroad are very clearly shown.

EUROPE.

ITALY.—Roma, Suburbio e Dintorni. Scale, 1:20,000, or .39 of a statute mile to an inch. Istituto Cartografico Italiano. Rome, 1904. Price, LI.50.

A very pleasing map based on detailed topographic surveys. White and five tints

of green are used to show elevation above the sea; and more detailed information relating to relief features is given by red contour lines with five metres as the contour interval. The scale is large enough for the legible printing of the names of many streets of Rome. The aqueducts, city limits, roads of various kinds, and much other information are given, and all places may be easily found on the map by referring to the index.

ITALY.—Carte delle Strade Ferrate Italiane. Scale, 1:1,500,000, or 23.6 statute miles to an inch. Ministry of Public Works. Rome, 1904.

Each system of railroads is distinguished by a separate colour; distinction is also made between single and double track roads, and between those in operation or only in process of construction. Fourteen insets show the position of railroad stations in the leading cities.

SCOTLAND.—Loch Beoraid (Morar Basin). Scale, 1:21,120, or 1 statute mile to 3 inches. *Scot. Geog. Mag.*, September, 1904.

This is another of the beautiful maps resulting from the bathymetrical survey of the fresh-water lochs of Scotland.

THE WORLD.

ECONOMIC.—Map of the Cotton-Growing Areas of the World (Mercator Projection). Compiled from Official Returns and Prof. Dunstan's Report. *Scot. Geog. Mag.* (July, 1904). Edinburgh.

The new information that the map adds to earlier cotton-growing maps relates to the areas where cotton is now being experimentally cultivated. The largest areas are in Africa, though the experiments are also being conducted on an important scale in Australia, northeast Borneo, the Malay Peninsula, and British Guiana.

ATLASES.

STIELER'S HAND-ATLAS.—Neue neunte Lieferungs-Ausgabe. 100 Karten in Kupferstich. Lieferungen 31–32 and 33–34. Justus Perthes, Gotha, 1904. Price 60 pf. for each part containing 2 map sheets.

Sheet 36 is a new map of the British Islands on the old scale of 1:3,700,000, or 58.3 statute miles to an inch; with much more data concerning the sea-floor around the islands than appeared in the earlier editions; insets of London, the Channel Islands and the Isle of Wight; 53 and 54 are revisions of sheets 3 and 4 of Vogel's 4-sheet map of the Balkan Peninsula, on a scale of 1:1,500,000, or 23.6 miles to an inch; 56, North and Middle Asia, is a new map of the Russian, Chinese, and Japanese Empires, on which the main features of our knowledge of the orography and hydrography of Asia are finely presented. None of the new maps appears in Parts 33 and 34, the sheets being revisions of plates 1 and 2 of the four-sheet map of the German Empire, and 3 and 4 of the four-sheet map of Austro-Hungary, all on a scale of 1:1,500,000, or 23.6 statute miles to an inch.

XUM

THE HUDSON RIVER DESCRIBED BY WILLIAM MORRIS DAVIS,

FOR THE EXCURSION UP THE HUDSON RIVER,

ARRANGED BY THE AMERICAN GEOGRAPHICAL SOCIETY,
THURSDAY, SEPTEMBER 15th, 1904,
for the foreign delegates to the Eighth International Geographic Congress.

Like the lower Potomac, the Hudson below Albany is not a normal river; its volume is not determined by the amount of rainfall upon its drainage basin, but by the depth at which its bed stands beneath sea-level. Its broadest part, from 23 to 35 miles north of the Battery (southern end of New York City), is about 3 miles across. On the eastern side of the lower river rise the uplands of schists and gneisses, their height gradually increasing northward. These crystalline rocks belong to the belt of the older Appalachians, stretching from New England to Georgia. They have been greatly deformed and eroded. On the western side of the lower river rises a bold escarpment known as the Palisades, the outcropping edge of a sheet of diabase that has been intruded between the layers near the base of the Triassic formation, which here dips westward. The unconformable contact of the Trias on the schists is in the river-bed. The Hudson Valley in this district follows the weak basal Triassic sandstones between the crystalline uplands and the Palisades.

Like the eastern uplands, the Palisades increase in height northwards and reach an altitude of 832 feet in High Tor, back of Haverstraw. Here the Palisades ridge turns westward and recedes from the river. Extensive beds of clay, probably of Post-glacial Age, are here worked for brickmaking. North of Haverstraw, crystalline schists are found on both sides of the river from Peekskill to Cornwall (12 miles). Here the river is less than a mile wide, and the hills, rising to altitudes of from 1,000 to 1,500 feet, are called the Highlands of the Hudson. They continue with similar altitude far northeast into New England and southwest across New Jersey into Pennsylvania.

Beyond Cornwall the river again widens, and the Highlands are replaced by a broad lowland, beneath which the river has eroded its course. This lowland is a part of the Great Appalachian valley, which follows the lower Paleozoic limestones and shales from Lake

Champlain southwest to Alabama. On landing at Fishkill on the east bank, ascent is made by trolley and elevator cars to Mt. Beacon, one of the summits of the Highlands, 1,835 feet above the river. The eastern escarpment of the Catskill Mountains (the northeastern part of the Allegheny plateau) may be seen to the northwest.

The relatively uniform increase in hilltop altitude from New York to the Highlands suggests that the valleys of to-day have been eroded in a formerly nearly even surface or plain, descending southward or southeastward. The plain runs indifferently across the rock structures of the region; hence it must be considered an ancient peneplain, the product of long-continued erosion when the land stood lower than now. Certain Cretaceous strata overlap the peneplain in Long Island and farther south; hence the peneplain may be regarded as produced by erosion in Jurassic and Cretaceous time.

The valleys of to-day can have been eroded only after the peneplain was uplifted to about its present altitude. Their erosion was accomplished in part of Tertiary time. Where the valleys have little depth the uplift of the peneplain must have been small; where the valleys have great depth, the uplift must have been strong. Where the rocks resist erosion, the valleys are narrow, as in the gorge through the Highlands; where the rocks are weak, the valleys are wide, as in the Great Appalachian valley.

Closer inspection shows that the Hudson occupies a trench that is eroded some 300 feet below the general floor of the Great Appalachian valley; hence there must have been a pause in the uplift of the peneplain, and this pause must have endured long enough for the erosion of most of the existing valleys; only at a relatively recent date did further uplift take place, for the trench in the great valley floor is much narrower than the Great Valley itself.

All this region has been glaciated, but it is difficult to give definite measure of the value of glacial erosion; it is believed to have been of moderate amount. Glacial drift is abundant on the lower land.

The present depth of the Hudson River bed below sea-level has ordinarily been explained by a depression of the land; but since it has been recognized that glaciers can erode below sea-level, it is difficult to say how much of the depth of the channel is due to depression of the land and how much to erosion by ice.

The extension of a navigable tide-water channel nearly 150 miles northward up the Hudson to Albany, and the opening of the Mo-

XUM

hawk valley west of Albany, between the Catskill (Helderberg) and the Adirondack Mountains has made communication easy between the harbor of New York and the prairies of the west. The contrast between the Hudson and the Potomac in this respect is very striking. The gorge of the Highlands is therefore a path of most active traffic, by rail (N. Y. Central R.R. on the east bank, West Shore R.R. on the west bank) as well as by boat; and New York is for this reason the commercial metropolis of the United States.

GAUSSBERG IN THE ANTARCTIC.

This picture of the isolated mountain discovered by the German Antarctic Expedition at the northern edge of the new land found by the party is selected from the illustrations accompanying Dr. Drygalski's report published in the *Zeitschrift* of the Berlin Geographical Society (No. 1, 1904). The land on which it stands was discovered on Feb. 21, 1902, and the next day the exploring vessel *Gauss* was frozen in the ice about forty-five miles north of the coast. The party were imprisoned here for nearly a year until Feb. 8, 1903, their position being Latitude 66° 30′ S., Longitude 90° E.

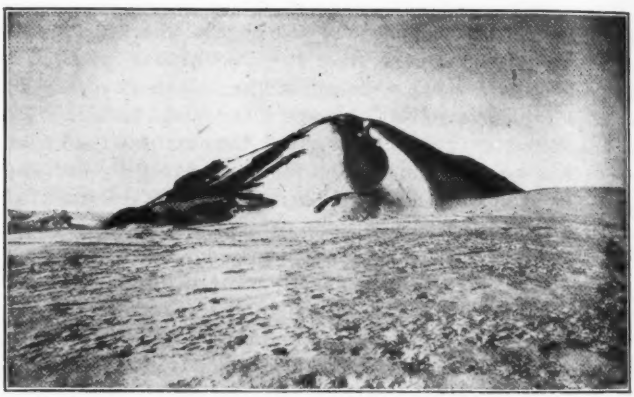
Gaussberg, as Dr. Drygalski named the mountain, rises from the sea edge to a height of 1,200 feet, and is of volcanic formation. The photographer, in taking this picture, stood on the inland ice to the southwest of the mountain, and the picture shows its southern face. Most of the side of the eminence is seen to be covered with snow, though wide streaks of the black lavas are in view. The northern face of the mountain, however, which confronted the sledge parties as they travelled from their ship to the land, showed only little patches of snow, the black block of lava contrasting strongly with the white sea-ice in front of it. Though the mountain was partly covered with snow, it was free from ice, and was the only bit of ice-free land seen by the Expedition.

Five months were spent in the sledging expeditions to the land, the objective points being the mountain and the seaboard, where scientific investigations, extending over weeks at a time, were carried on. It was difficult to reach the mountain, as the distance from the ship was forty-six miles over rough sea-ice. It would have been much easier, after gaining the land, to travel southward over the inland ice that covered it; but the explorers saw no purpose to be gained from such a journey, as they could see from the summit

of Gaussberg "only a far-reaching ice-capped hinterland, and had nothing to expect from the interior more than a long journey over uniform undulating ice, such as they had already seen on the coast."

They were very busy, however, with their scientific studies on the shore and mountain, where they investigated all the phenomena presented. Dr. Philippi studied the Gaussberg lavas. The moraine that was evidence of former ice action on the sides of the mountain was also an object of attention. The scientific results are now being worked out, and no detailed description of the mountain and the coast will be written until they are completed.

The lavas of the mountain contain molten gneisses that had been forced up with them from the bed-rock; and the traces of ice



GAUSSBERG ON KAISER WILHELM II. LAND.

action on Gaussberg show that the surface of the ice-cap formerly stood at a higher level than at present, and that the glacial area was, doubtless, more extensive than it is now. Dr. Drygalski believes this is the vastest glacial area existing at the present time.

The land around the mountain consists of old crystalline rocks. This was only one of many proofs that the party were living and working on the fringe of the south polar continent. The discovery of the coast, which they named Kaiser Wilhelm II. Land, cleared up, for over ten degrees of longitude, the old-contested question regarding the nature and extent of that part of the Antarctic land-mass to the south of the Indian Ocean. There can now be no misunderstanding as to the approximate extent of the continental coast-line for at least half the distance between Knox and Kemp Lands.

GEODETIC SURVEYING, TOPOGRAPHICAL WORK, AND MAP-MAKING IN MADAGASCAR, 1903.

BY

WILLIAM H. HUNT.

The year 1903 was a peculiarly fertile one in work pertaining to surveying, topographical, and ordnance maps in the different districts of Madagascar, by some of the most experienced and able officers of the army of occupation.

To speak first of the geodetic survey of Madagascar. This has been carried out by three triangulations—one central, a line being drawn from Diego Suarez in the extreme north to Fort Dauphin, the two others along the coasts, and all connected by transversal section lines, so as to cover the whole island with a network of outlines, leaving the intermediate spaces to be filled up later on as information is forthcoming. Of these three systems of triangulation the central one and the west coast one (from Mojanga to St. Mary's Island) were surveyed previous to 1902. The third, which skirts the east coast, was undertaken in 1902, and surveyed over a distance of 106 miles, from Andovoranto to Mananjary, by officers of the French Colonial Artillery. Last year's work included the prolongation of this line from Mananjary southwards as far as Fort Dauphin, a distance of 248 miles, where it joined the central line drawn from Diego Suarez to that place; and the completion of a transversal section line from Fianarantsoa to Mananjary, which had been commenced in 1900.

The whole work was divided into four sections, and was carried out under the direction of Captain Milhau, an able infantry officer.

The new triangulation, comprising triangles with length of sides about 12 to 18 miles, and completed by a close network with the intermediate points, is joined to the north through Mananjary to the extremity of the portion of the line already drawn, and to the south it joins the central triangle, one of the sides of which was taken as a base.

This work, by ensuring the position of a great number of fresh points, has been the means of determining in a definite manner the outline of the east coast, about which the old maps were frequently in doubt. It also helped to establish the correctness of the preceding triangulations, which in many points coincided perfectly with the new calculation.

The Reverend Father Colin, a missionary of the Society of Jesus, who has lived in the island for more than thirty years, the director and, in fact, the originator of the Ambohidempona Observatory near Antananarivo, is probably the most able mathematician that Madagascar has ever known, and, while still devoted to his works on meteorology and magnetism, has completed a very close triangulation of the west of Antananarivo. This will serve as a base for surveying the environs of the capital with a very long radius.

While the geodetic officers were carrying out these triangulations, the Topographical Department was preparing a rough plan of the districts traversed on a scale of $\frac{1}{100000}$. Three lieutenants of infantry prepared respectively maps of Fianarantsoa, the province of the same name, and the province of Mananjary, and fixed for a long time the topography of those regions. Captain Sancery was entrusted with a similar task for the province of Tamatave, and surveyed the valleys of the rivers Ivolonia and Ifontsy, carrying the triangulation of the East to the last-mentioned river. At the same time officers of the Antananarivo garrison made a plan of that city and suburbs with a 12-mile radius on the scale of $\frac{1}{50000}$. This work was based on the existing triangulation. Father Roblet, following up his topographical survey of Imerina, the central province, to which he devoted years of labour long before the French took possession of the island, has been revising many parts of his observations, particularly near the river and sources of the Onivé, a tributary of the Mangoro, which runs into the sea at Mahanoro (east coast).

A great number of plans and itineraries in various parts of the island have been added to the documentary geography of Madagascar. Some have made us acquainted with still unexplored regions; others have corrected old documents. Amongst the more important of these works may be mentioned a fairly complete map on a scale of $\frac{1}{200000}$ of the district of Fort Dauphin; another of the province of Fianarantsoa on a scale of $\frac{1}{100000}$; and a very exact map of Diego Suarez, destined to be the naval defence of the East Indian station; maps, also, of the province of Mananjary, Bemaraha, and Bongo Lava—names which convey little to the ordinary reader, but which bear witness to the thorough attention devoted to the scientific geographical knowledge of the island. Not to be omitted is a map of the district of Morondava on the southwest coast, contributed by the Compagnie Lyonnaise, a commercial company.

The chiefs of provinces and districts, responding to requests made by the Governor-General Gallieni, have sent in to the Topographi-

cal Office in the form of itineraries and locations of halting-places the elements suitable for the preparation of a new map, more in accordance with the present progress.

The Mining Service under the direction of Captain Monneyres has been assiduous in keeping the Topographical Department informed of everything learned through reports from its agents and from prospectors.

Before the occupation by the French but little was known of the geography of Madagascar. Missionaries traversed it, and made some limited explorations on the line of their journeys. Naturalists in search of collections also furnished information, and frequently paid with their lives their devotion to science; but not until now could it be said that the mapping of the island was seriously undertaken.

About the close of the year 1902 a map of Madagascar, on a scale of $\frac{1}{1000000}$, engraved and in colours, was ready to be struck off, and it was published in its entirety early in 1903. There is a new map on a scale of $\frac{1}{500000}$ now in press, so arranged that blank spaces are left to be filled up by information received at the last moment. This new map, in seven colours, consists of 20 sheets, five of which are already issued.

In 1902, Governor-General Galliene, who is an enthusiast on the subject, ordered a general atlas of Madagascar to be prepared. The work was immediately put in hand by his staff; but the numerous changes that had to be made in order to render the work as exact as possible have delayed its publication, and it will be issued in 1905. This atlas will contain about 40 engraved maps, in colours.

The drafting and engraving connected with the Topographical Offices in Madagascar are done entirely by Malagasy, and their work in the edition of the map on a scale of $\frac{1}{1000000}$ was truly remarkable. It may be said that it will compare very favourably with the publications of the best French houses in map productions.

Besides these maps the Topographical Bureau has published a new temporary map of the stages and halting-places of the roads intersecting Madagascar on a scale of $\frac{1}{1000000}$, and in addition has produced for the official publications of the colony some 300 maps, representing more than half a million copies.

July 6th, 1904.

BOOK NOTICES.

On the Distribution of Rain over the British Isles during the year 1903. Compiled by Hugh Robert Mill. 8vo. London, 1904. pp. 300.

British Rainfall, which is the more familiar title of this volume, is the most important and most complete regular publication on rainfall issued in any country. For many years compiled by Mr. G. J. Symons, it has, since Mr. Symons's death, come into the hands of Dr. Mill, who is carrying on the British Rainfall Organization, is editing *Symons's Meteorological Magazine*, and is compiling the annual rainfall volume. Dr. Mill is so well known to geographers and to meteorologists that there is no need to call attention to the good fortune which has brought him to his present position at the head of the British Rainfall Organization, which is, in many respects, a unique meteorological body in the world.

British Rainfall for 1903 contains several entirely new sections, although the original plan of the volume has been kept without interference. The year 1903 having been one of abnormal rainfall in the British Isles, the present volume is of unusual interest. The number of observers is now nearly four thousand; and as a result of the interest of the King, the rainfall records at Balmoral and Sandringham are now sent in regularly to Dr. Mill, and a new gauge has been set up at Buckingham Palace. Mr. H. Sowerby Wallis, who was associated in the work of the Rainfall Organization with the late Mr. Symons, and afterwards with Dr. Mill, has now retired altogether. A new section dealing with the duration of rainfall has been introduced. The special articles deal with "The Three Wettest Years of British Rainfall," of which 1903 was one, and with "The Daily Rainfall of June, 1903." At Camden Square, London, the rain began at 1 P. M. on June 13, and continued without a moment's intermission until 11.30 P. M. on the 15th—a total duration of 58½ hours, yielding a total fall of 3.44 ins. This one long-drawn-out shower of nearly three days' duration accounted for 53% of the duration and 53% of the amount of the month's rain. The remarkable feature of the three-days' rain was that it was practically continuous at the average rate of .001 in. *per minute* for the whole time. We are particularly pleased with the discussion of "Heavy Rains on Rainfall Days in 1903," in which each remarkable case of a widespread fall is illustrated by a

map, and cordially agree with Dr. Mill that these charts "will ultimately prove of great value in discussing the distribution of heavy rains in relation to thunderstorms and cyclonic movements." The emphasis on the cyclonic unit in the discussion of rainfall amounts and distribution is certain to increase in the future, as the study of climatology concerns itself less with mere monthly and annual averages, and deals more with the cyclonic controls of the different elements. Discussions of "Rainy Spells in 1903," of "Rainy Days in 1903," and of the "Intensity of Daily Rainfall" add 17 pages of entirely new matter. Monthly rainfall is considered in greater detail than heretofore, and the maps are on a larger scale than formerly.

It is a matter of regret to note that the total amount received in subscriptions to the work of the British Rainfall Organization has fallen off; for the financial responsibility assumed by Dr. Mill is great, and he deserves the heartiest support of his observers, as well as of scientific societies and all other persons in any way interested in British meteorology. R. DEC. W.

The Book of Italian Travel (1580–1900). By H. Neville Maugham. lx and 459 pp. and four illustrations. London: Grant Richards, 1903.

The book consists of selections chosen with much skill from the writings of men, many of them famous, who have travelled in Italy within the past four centuries. The design is to use this travel-literature so as to give the reader a better general idea of Italy than he derives from the many specialized books now published. The compiler does not attempt to give a complete picture of the country, but only to collate such passages from old and modern writers as will give a synthesis of the art and character of the most typical Italian towns. The plan is carried out with sympathy and excellent taste. A philosophical introduction by the editor opens the way to this gallery of pictures of the glories of the classic Peninsula.

Sweden: Its People and its Industry. Historical and Statistical Handbook. xi and 1141 pp. Many maps and illustrations. Edited by Gustav Sundbärg. Published by order of the Government. Stockholm, 1904.

The English edition of Norway's Handbook of Statistics on the cultural and industrial conditions of that country was published some time ago, but the similar Handbook of Sweden has only just

appeared in its English dress. These works have now been issued in Norwegian and Swedish respectively, and also in French and English, the French editions coming first, as the books were primarily intended for the Paris Exposition of 1900.

The Norwegian handbook is regarded as the fullest and most authoritative source of information with regard to all aspects of that land and nation; and the Swedish handbook is fully as serviceable for Sweden. It is larger than the other book, and more abundantly illustrated with maps and pictures. Few Governments have done so much as Norway and Sweden have done in these handbooks to diffuse a correct idea of their countries and peoples. The geography and geology of Sweden are treated at length, and the large number of maps give sociological and a large variety of other information.

Le Tibet. Le Pays et les Habitants. By F. Grenard. Avec une Carte en couleur hors texte. iii and 387 pp. Armand Colin, Paris, 1904. (*Price, fr. 5.*)

This volume has been published at the moment when particular attention has been drawn to Tibet by the British invasion of that country. The book is partly a condensation of the large and costly work in three volumes which the author published in 1897–98 ("Mission scientifique dans la Haute Asie"). Mr. Grenard was the companion and collaborator of the late Dutreuil de Rhins in his Asian itineraries, and two-thirds of the present book is given to a graphic narrative of the Tibetan journeys of that great explorer, who met a tragic death among the turbulent populace of eastern Tibet. The second part deals in a very adequate and interesting manner with the Tibetans and their country—their physical and intellectual condition, history, industries, commerce, religion, and government. No traveller has studied more closely than Grenard the subjects of the Lhassa Government; and this volume, which is not only authoritative, but also convenient to handle, cheap in price and well printed, is a welcome addition to our sources of information.

Documents scientifiques de la Mission Saharienne. Mission Foureau-Lamy d'Alger au Congo par le Tchad. Par F. Foureau, Chef de la Mission. Publication de la Société de Géographie. 4to. Paris, 1903. Premier fascicule. pp. 162.

The *Mission Foureau* left southern Algeria, October 23, 1898, and reached France, on its return, September 1, 1900, having in the

meantime crossed Africa to the Congo by way of Lake Chad. The Société de Géographie of Paris has undertaken the publication of the scientific results obtained by the expedition, and the first volume of the *Documents scientifiques* of the *Mission Saharienne* concerns the astronomical and meteorological observations. To speak in detail of the latter would occupy more space than can be given to this notice; but it may be stated that the meteorological work done was most careful, and is of great value. Regular observations were made throughout the whole journey three times daily; while self-recording instruments gave records whenever halts were made, and sometimes even during the march. Full notes were also kept of the state of the sky, the direction and velocity of the wind, fogs, dew, thunderstorms, etc. The districts traversed, which were all most interesting climatically, may be classified in four zones, as follows: I, The typical Sahara and Aïr, from Lat. 32° N. to 20° N.; II, From Lat. 20° N. to about 15° N., the district of Aïr; III, Sudan, Chad and Bas-Chari, between Lats. 15° and 12° N.; IV, The subequatorial and equatorial region, from Lat. 12° N. to the Equator. For many reasons these latitudes of northern Africa are perhaps as important from a meteorological point of view as any in the world; hence the great value that attaches to the observations contained in the present volume.

Attention can be directed to a few only of the more important facts noted in the pages before us. The thermometer fell below freezing twenty-five times during the months of December, 1898, and January, 1899, at altitudes of 960 to 1,445 metres above sea-level. The minimum reading was 13.6° on January 3, at 1,144 metres. The maximum temperature recorded was 118.9°, on March 9, 1900, at Koussri. Mention is made of the fact that the high temperatures noted in Aïr (109.5 to 111° maximum in the shade) were not at all insupportable when one sat still. Haze, due to dust, was frequently observed, being brought by winds of different directions, and sometimes occurring during calms. These dust-fogs were noted with winds from southeast or southwest in Algeria, and from northeast in Aïr, and around Lake Chad. During the whole journey winds between north and east were most frequent. In the Sudan region winds between north and east dominated; while in the Saharan zone there was an equal prevalence of winds between north and east and between south and east. The northern limit of the northeast trade was found at about Lat. 16° 17′ N. (October 20), and the southern limit at about Lat. 12° 5′ N. (March 6). South of latitude 12° a zone of variable winds, chiefly from the south and south-

east, was met with. These observations show that the southeast trade extends well to the north of the ordinary zone of the equatorial belt of calms. A hot wind, known by the Arabian name of *chihili*, was found to have very unpleasant effects upon human beings, drying the throat, and causing an intense thirst and extreme irritability. Many desert whirlwinds were carefully observed in the Aïr region, and are well described (pp. 82–83), but it is rather surprising to find that the whirls were always clockwise. Observations made by the present reviewer on the deserts of Peru failed to show any rule in the matter of the direction of whirling. "Tornadoes"—*i. e.*, dry thunderstorms—with wind and without rain, were observed several times. The thunderstorms of the Aïr region showed the characteristic tropical regularity of occurrence, "toujours vers 3 heures, et jamais après 5 heures de soir." Dew was noted fourteen times, and hail once, on July 17, at Aoudéras (Aïr).

As to rainfall, the observations indicate that the tropical rains seldom reach the Aïr district, and then are only scattering, irregular, and uncertain showers, although these very showers may cause marked rises in the streams. Nevertheless, thunderstorm rains are much commoner here than in the northern Sahara, the vegetation is denser, and arborescent vegetation is represented by more varieties. Pages 98–157 are taken up with tables of meteorological data, and there are also reproductions of several thermograph and hygrograph curves, illustrating (1) certain days with high temperatures; (2) days with thunderstorms; and (3) days with abnormally high nocturnal humidity. It is to be noted that the selection of type curves of this kind, showing *unusual* conditions, seems to us a distinct gain over the usual practice of reproducing only *normal* curves for a month or a year. The discussion of climatology is altogether too much concerned with the averages, and does not give nearly enough attention to the extreme or abnormal values of the various weather elements, nor to the general weather controls under which these extreme or abnormal values occur. Those who are interested in African climatology will need to make a careful study of this volume of the *Mission Saharienne*. R. DEC. W.

Researches on the Past and Present History of the Earth's Atmosphere, including the Latest Discoveries and their Practical Applications. By Dr. Thomas Lamb Phipson. 8vo. London, 1901. Pp. xii, 194.

In the case of the volume before us the title is much too ambitious for the book. We have here a rather rambling, pleasantly-written, and fairly instructive series of chapters on the earth's

atmosphere, much of what is written being the result of the author's own observations. It cannot truly be said that all "the latest discoveries" are included, but the scientific reader, and many unscientific readers also, will find the book interesting. As a "popular" account of some of the relations of man to the atmosphere the volume will find a place, but it is neither a well-digested nor a complete discussion of the subject of its title.

R. DEC. W.

Klimatographie von Niederösterreich. Von J. Hann. Herausgegeben von der Direktion der K. K. Zentral-Anstalt für Meteorologie und Geodynamik. 4to. Vienna, 1904. pp. 104. Pl. 1.

The acknowledged master of climatology has written on the climate of his own country. The present volume is the first of a series of reports to be issued as rapidly as possible under the auspices of the Austrian Central Meteorological Institute of Vienna, dealing with the climates of the different portions of the Austro-Hungarian monarchy. It was as fitting as it was natural that Hann, who stands at the head of the world's workers in meteorological science, should be chosen to prepare the first volume in the series. This he has written with the thoroughness, the accuracy, and the systematic arrangement of details which distinguish all his work. As an authoritative study of the climatography of lower Austria; as a model for the remaining volumes of the same set, and of monographs on the climate of other countries; as an additional proof of the debt which meteorology owes to its master, this report has a value which it is impossible to over-estimate.

R. DEC. W.

The United States, with an Excursion into Mexico. Handbook for Travellers. By Karl Baedeker. ciii and 660 pp., 25 Maps and 35 Plans. Third Revised Edition. Karl Baedeker, Leipzig, 1904.

This guidebook meets the needs of foreign visitors to the United States so well, and has been so useful to our own tourists at home, that this new edition, bringing it up to date, will be welcomed. Fourteen new maps and plans have been added. The excellent maps in the Baedeker guidebooks are especially noteworthy when they illustrate our own pleasure resorts and show places, because, although they are made in Germany, they are based upon the Government topographic surveys wherever possible, show topography clearly, indicate footpaths and roads as well as railways, and make the special points of interest stand out.

A. Hartleben's Kleines Statistisches Taschenbuch über alle Länder der Erde. Eleventh Year. Compiled by Prof. Dr. Friedrich Umlauft. Vienna and Leipzig, 1904.

This book of 104 pages, which may easily be slipped into a small pocket, contains the most important statistics of all nations. The countries are arranged alphabetically, and an index also makes it easy to turn to any of the information with which the book is packed.

Africa from South to North through Marotseland. By Major A. St. H. Gibbons, R.C.I. With numerous illustrations, produced from photographs and maps. Two volumes. John Lane, London and New York, 1904.

This is an account of the author's explorations and travels in Africa from 1898 to 1900. Major Gibbons's work in Africa has been done with the idea that the first purpose of pioneer exploration should be to compile an accurate map, so that scientific discoveries may be definitely located; and to give by map and letterpress such an insight into the general features of a country and its people as to help pioneers most advantageously to mature their enterprises. In both his journeys Major Gibbons kept these primary objects before him, and this is the reason why his work takes high rank among the geographical achievements of recent years. These two volumes, containing 613 pages, give the results of the most comprehensive study yet made of the wide empire of Marotseland, which occupies practically all of the upper Zambezi basin, is nearly as large as Texas, and is ruled by King Lewanika, who in thirty years has greatly increased the size and strength of his country. The king is a man of much tact as well as great power, and the Marotse are among the brightest and most promising of African peoples.

In 1895–96 Major Gibbons studied and mapped southeastern Marotseland. The principal purpose of his last journey was to carry out similar work in the remaining three-fourths of that region. His routes and those of his assistants extend over all parts of the country—too large a region for one enterprise to exhaust, but Major Gibbons has made rich contributions to our knowledge of it.

To reach Marotseland, Major Gibbons ascended the Zambezi from its mouth, and ultimately traced the river to its fountainhead, whose position he fixed. Nature, he says, has divided this fourth largest river in Africa into three sections: the lower navi-

XUM

gable river, extending from the sea about 400 miles to the Kebrabasa rapids, where navigation is interrupted for forty miles; the middle river, from the Kebrabasa rapids to the Victoria Falls, 900 miles, of which 800 miles are easily navigable for nine months in the year; and the upper river, from the falls to the source, some 600 or 700 miles, of considerable value, also, for navigation. With its great affluent, the Lungwebungu, the navigable reaches stretch three-fourths of the way across the continent, and their sum amounts to nearly 4,000 miles. He believes improvements can be made at the Kebrabasa rapids which will enable boats to travel 1,200 miles from the delta without transshipment.

The river has its origin in a deep depression at the base of steep wooded undulations rising very abruptly for the first thirty feet and then with decreasing steepness for another twenty. The water oozes from black, spongy bog, and quickly collects into a definite stream of clear, cool water. Tall trees thickly covered with creepers spring from this basin and enclose the river-bed for the first few hundred yards of its course. Major Gibbons fixes the position of the source at 11° 21′ S. Lat. and 24° 4′ E. Long.

The author thinks that Marotseland has every prospect of a satisfactory future, not only in its pastoral and rubber-producing areas, but also on its large plateaux, from 3,500 to 5,000 feet above the sea, where cereals, fruits, and many commercial products may be grown, and where, in his opinion, European settlement is practicable.

Having completed his surveys in Marotseland, Major Gibbons returned to Europe by way of Lake Tanganyika and the Nile. He regards the mountainous country around Lake Kivo, a little north of Tanganyika, as one of the most promising, and quite the most healthful, he has seen in his thousands of miles of African travel. Fever finds no place among the magnificent highlands of Ruanda, 5,000 to 6,000 feet above the sea. The people are far in advance of the average African tribe in agricultural attainment, and their well-tilled fields of grain, sweet potatoes, beans, and peas bear a resemblance to the farms of southern Europe. The author says:

> Considering the healthiness, the richness of soil, and the attractive nature of the Kivo regions, there is little doubt that the facilities offered by railway communication will be quickly followed by the settlement of European colonists on an extensive scale.

The publisher has been good enough to back with linen the two largest maps, which have been produced with great care. The map of the upper Zambezi basin shows the distribution of tribes

under Lewanika's rule, and distinguishes with blue the navigable portions of the rivers. Most of the information on this map is based upon the surveys and explorations of Major Gibbons and his assistants, and shows how little had been done before them to reveal this great region in its entirety.

The photographic illustrations are fairly successful, and nearly all render sufficiently clear the characteristic aspects of peoples and countries. A series of views of the Victoria Falls are among the best yet taken of this wonder of the world. The volumes will be an authority for years on the parts of Africa of which they treat, but they will also be read with profit and pleasure by all who enjoy stories of adventure and discovery in little-known lands.

Normal Monthly and Annual Means of Temperature, Pressure, Wind, Humidity, Cloud, Rainfall, and Number of Rainy Days of Stations in India, etc. By Sir John Eliot, M.A., F.R.S., K.C.I.E. Indian Meteorological Memoirs, XVII. Fol. Calcutta, 1904. pp. lxi + 288.

The latest number of the *Indian Meteorological Memoirs* is by Sir John Eliot, who retired from his position as Meteorological Reporter to the Government of India last December, and contains the normal data prepared for the completion of the Climatological Atlas of the Indian Empire, the publication of which has been sanctioned by the Government of India. The title of the volume gives a sufficient indication of the scope of the work. The data are given with great completeness, and are preceded, in the Introduction, by tables containing corrections for reducing the various readings to true means. A publication which, like this present one, is almost wholly tabular, does not call for extended notice in the BULLETIN, but as a source of authoritative information on the climatology of India it merits at least these few lines.

R. DEC. W.

La Conquête du Pôle. Histoire des Missions arctiques depuis les Temps les plus reculés jusqu'à Nos Jours. By Charles Bénard. xvi and 383 pp., nearly 300 Illustrations, Maps, Bibliography, and Index. Hachette & Co., Paris, 1904.

The book gives a good general description of Arctic exploration. It does not pretend to be exhaustive, though most of the smaller expeditions are mentioned. No effort is made either to discuss or to settle disputed questions. After a chapter on the physical conditions and the human and other inhabitants of the

Arctic, the author tells the story of Arctic enterprise from the first visitors in northern seas and lands to the present time. It is a bird's-eye view of the subject, agreeably presented, usually accurate, with emphasis on the most important and interesting facts. The excellent compilation is marred to some extent by a considerable number of small blunders that may easily be corrected. It is strange that the highest north of Lockwood and Brainard is not mentioned in the account of the Greely Expedition, though referred to in the pages devoted to Peary; also that Peary's highest north in the western hemisphere in 1902 is not mentioned in the text, though recorded on the map. Most of the illustrations are reproduced from fine photographs, of which Peary contributed a large number. The book is handsomely printed on heavy paper.

The Khedive's Country. The Nile Valley and its Products. Edited by G. Manville Fenn. 180 pp. and 27 illustrations from photographs. Cassell & Co., London and New York, 1904.

The book tells of the capabilities of the soil in Egypt and how agriculture in all its branches is carried on. Much of the information was derived from the superintendent of the Khedive's agricultural estates, who has spent years in studying the problems of irrigation, reclaiming lands, forming model farms and experiment stations, and improving live stock. He told of many things that are not seen by the casual visitor. The extent of land under cultivation is greatly increasing, and the Government has established a college at Ghizeh to instruct the sons of native landowners and of the working fellah class in more advanced agriculture and the best modern ways of farming. Many of the modern agricultural implements and machines have recently been introduced. There is no doubt that the Egypt of the future will vastly surpass the present in productivity.

Old and New Architecture in Khiva, Bokhara, and Turkestan. By O. Olufsen, First Lieutenant in the Danish Army and Chief of the First and Second Danish Pamir Expeditions. Folio. Twenty-six Plates, with descriptive letterpress. Copenhagen, 1904.

During the Pamir scientific expeditions led by Lieut. Olufsen in 1896–97 and 1898–99 his party travelled extensively in Transcaspia, Khiva, Bokhara, and Turkestan. The opportunity was improved to take photographs and drawings of old and new architecture. Selections of this material have been finely reproduced for this volume. The text explains that the glazed tiles and tiled mosaic

adorning the walls, domes, minarets, palaces and sepulchres whose delicate and beautiful ornamentation are shown in the plates are rarely found in dwellings, as private persons could not afford to indulge in such luxuries. The tiles are principally used in mosques, madrasas [schools], and mausoleums. When art flourished it was employed first and foremost in the service of religion, in order to give the devotee the idea of something exalted far above every-day things. The descriptions of the tiling, faïence, wood carvings, and other ornamentation illustrated in the plates are instructive and interesting; and the volume should help to attract attention to the art of this portion of inner Asia, whose ancient history and culture are still so little known.

Handbook for East Africa, Uganda and Zanzibar, 1904. pp. 223. Printed at the Government Printing Press, Mombasa, British East Africa Protectorate, 1903.

Like many handbooks relating to the newer parts of the world, this little volume is packed with information of interest to those who watch the progress of pioneer development. It sketches the history of the East Africa and Uganda Protectorates; gives lists of all officers who are serving or have served there; tabulates commercial information; describes the ports; shows the progress during the previous year in the public works; gives the time of the arrival of trains, the fare, and the height above sea-level for all stations on the Uganda R.R. from Mombasa to Victoria Nyanza, and also prints the game laws and much other information. A very good idea may be obtained from such compilations of the progress that is being made in regions that are just coming within range of civilizing influences.

Japan. Das Land der aufgehenden Sonne einst und jetzt. Nach seinen Reisen und Studien geschildert von Dr. Joseph Lauterer. vii. and 407 pp., 108 Illustrations, a Map, Bibliography and Index. Second Edition. Otto Spamer, Leipzig, 1904. (*8.50 marks.*)

A popular book on Japan, but written on a different plan from that of travel-books. It is not filled with the impressions of a casual observer, but is the work of a practising physician, who has lived long in Japan and knows the language and the people. An historical section, occupying nearly half the book, is devoted largely to the influences and tendencies that have shaped Japanese civilization, to the exclusion of dry details relating to military campaigns

and changes of rulers. Much material for this part of the book was derived from native libraries. Then follow chapters on the physical and intellectual characteristics of the Japanese, their language, ways of living, food, clothing and shelter, art and industries, trade, farm crops, and methods of farming. The book concludes with several chapters on the geography, geology and climate, the flora and fauna, and characterizations of the chief cities. Many of the pictures are new photographs, and many others are from Japanese woodcuts. The book is filled with informing matter, and it would be hard to find a better compendium of facts relating to Japan.

Rhodésie et Transvaal. Impressions de Voyage. By Albert Bordeaux. 284 pp., Illustrations and Map. E. Plon, Nourrit & Co. Paris, 1898.

Sketches of the country and people, brightly written and readable. No attempt is made to treat the economic or other more serious aspects of these regions.

NOTES AND NEWS.

THE EIGHTH INTERNATIONAL GEOGRAPHIC CONGRESS.—The Congress met in Washington on September 8–10, and its sessions and field meetings were continued in Philadelphia, September 12; in New York, September 13–15; Niagara Falls, September 16; Chicago, September 17; and St. Louis, September 19–22. As the business sessions and scientific meetings of the Congress were distributed among these various places, it was impossible to secure all the important data in time for this number of the BULLETIN. It has been decided, therefore, to defer the report of this very interesting meeting of the Congress in America until a later number of the BULLETIN, when its history may be adequately presented.

Communications received in August from Mr. F. H. Nichols describe his progress to the 4th of June, when he reached Chamutong on the Lu-Kiang River (Salwin). He had been delayed in his journey westward by heavy snow in the mountains, but resumed his task early in May, and on the 7th arrived at the Lan t'sang River,

which he crossed on a bamboo rope stretched from bank to bank—a distance of 500 feet. The process was trying to the nerves, but simple enough.

The hither end of the rope was at a higher point than that fastened to the farther bank. A wooden block, closely fitted to the rope and sliding freely, served as a saddle, from which the traveller was suspended, securely fastened by leather straps. When all was ready, one of the men pushed Mr. Nichols, who shot along the rope, as he writes, in a minute and a half, to the other side of the river, losing only his breath. The mules and horses were transported in the same way.*

At Cheku, beyond the Lan t'sang, Mr. Nichols was received at the Jesuit Mission by the two French priests.

One of these gentlemen told Mr. Nichols that since T. T. Cooper in 1868 the only foreign visitors to the Lan t'sang valley were Henri d'Orléans and his companions—Lieut. Roux and M. Briffaud—Maj. Manifold, Capt. Diez, and Mr. Nichols himself.

The rainy season was beginning when Mr. Nichols arrived. In this mountainous region intersected by deep valleys, lying between the Lan t'sang and the Brahmaputra Rivers, the snowfall is very heavy. The snow melts in June and July; and this, in Mr. Nichols's judgment, accounts for the lateness of the floods in the Chinese rivers.

About Cheku and in the valleys to the west the land was full of flowers. The rose-bushes were like trees, and there were at least ten varieties of rhododendrons.

It was the 28th of May when Mr. Nichols started from Cheku in a pouring rain to climb the mountains. The rain continued for three days, and the first of June found the party encamped for the night on a hill, whence they looked down the next morning on the Lu Tsang River, which Mr. Nichols identifies with the Salwin. On the bank of the river was the house of Father Villesesche, the priest in charge of the mission at this point. Here the party rested for three days, and on the 4th of June Mr. Nichols records his arrival at Chamutong; with the words: "Now for the Brahmaputra."

* Prince Henri d'Orléans in his book, *Du Tonkin aux Indes*, p. 200, gives an illustration of this kind of bridge, showing a mule hung in the middle of a rope, with the two ends far above him; yet the Prince himself had crossed such a bridge.